
**U.S. Army
Chemical Materials Agency**

**Programmatic
Monitoring Concept Plan**

Final

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Chemical Materials Agency**

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Monitoring Concept Plan**

Final

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**CHANGE PAGES FOR
CMA PROGRAMMATIC MCP**

LIST OF EFFECTIVE PAGES

Date	Subject Matter	Remove Page No.	Insert Page No.

Insert latest changed pages. Destroy superseded pages.

NOTICE

This Programmatic Monitoring Concept Plan (MCP) for the U.S. Army Chemical Materials Agency (CMA) addresses all major requirements of chemical agent and non-stockpile industrial chemical monitoring involving the CMA.

This CMA Programmatic MCP includes monitoring requirements for monitoring devices that detect chemical warfare materiel (CWM). The descriptions and corresponding operational requirements of these devices are provided at the government's request to illustrate the concepts discussed. Inclusion in this report does not necessarily represent endorsement of a product, nor should exclusion of additional products that may exist and be applicable to CWM monitoring operations represent a lack of endorsement.

FOREWORD

The U.S. Army Chemical Materials Agency (CMA) has issued a Programmatic Monitoring Concept Plan (MCP) to address all major aspects of chemical agent and non-stockpile industrial chemical monitoring. The CMA Programmatic MCP will be implemented when chemical detection (chemical agent and industrial chemicals), screening, and analyses are required to support storage, transportation, and destruction of chemical warfare materiel. The CMA-Risk Management Directorate (RMD) is the governing authority for this document and will provide final interpretation on all requirements.

The CMA Programmatic MCP requires CMA laboratories and monitoring teams to: (1) develop a site-specific monitoring plan; (2) undertake specific monitoring activities to ensure that chemical materiel is detected with acceptable confidence; (3) perform corrective actions as necessary to ensure the validity of laboratory and monitoring data; and (4) comply with all Department of Defense directives, federal laws and regulations, U.S. Army regulations, and environmental permits.

For clarification purposes throughout this document, references to the requirements of the CMA Programmatic MCP will refer to this document.

Adherence to the requirements of this CMA Programmatic MCP will ensure that the missions to treat, dispose, store, and transport chemical warfare materiel are performed with the highest regard for the safety of the workers, communities, and environment.



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Director

U.S. Army Chemical Materials Agency



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1. INTRODUCTION

1.1 Purpose

The purpose of the CMA Programmatic Monitoring Concept Plan (MCP) is to provide technical and administrative requirements to support monitoring and sampling operations conducted during U.S. Army Chemical Materials Agency (CMA) activities. The CMA Programmatic MCP shall be used at each site for developing a site-specific monitoring plan that incorporates additional Federal, State, and local regulatory requirements. The site-specific monitoring plan shall be submitted to the CMA-Risk Management Directorate (RMD), ATTN: AMSCM-RD, Aberdeen Proving Ground, Maryland 21010, for approval.

1.2 Scope

The CMA Programmatic MCP outlines minimum requirements of chemical materiel monitoring necessary to support CMA activities, which will include: (1) monitoring requirements for chemical warfare materiel (CWM) in air, liquid, and solid matrices; (2) monitoring levels and exposure limits; and (3) documentation requirements. The CMA Programmatic MCP is based on requirements defined in Department of the Army (DA) Pamphlet (Pam) 385-61. This document defines requirements for CMA activities and operations relating to storage, treatment, and disposal of chemical materiel as specified in table 1-1. Requirements for closure activities will be provided under separate guidance. If the CMA Programmatic MCP is different from or conflicts with other codes or regulations from state and/or federal authorities, the CMA-RMD is to be notified for resolution of the conflict and the most stringent requirement shall be followed, pending resolution.

All other potential chemical hazards shall be addressed by the site in an industrial hygiene plan, health and safety plan (HASP), emergency response plan, or other similar documentation.

Table 1-1. Applicable CWM

Symbol	Chemical Name
H, HS	Bis-(2-chloroethyl) sulfide with polysulfides
HD	Bis-(2-chloroethyl) sulfide
L	Dichloro-(2-chlorovinyl) arsine
T	Bis-(2-(2-chloroethylthio)ethyl ether
Q	1,2-bis(2-chloroethylthio)ethane
Mustard Mixtures: HL, HT, HQ	
HN-1	Bis-(2-chloroethyl)ethylamine
HN-3	Tris-(2-chloroethyl)amine
GB	Isopropyl methylphosphonofluoridate
GD	Pinacolyl methylphosphonofluoridate
GA	Ethyl N,N-dimethylphosphoramidocyanidate
VX	O-ethyl S-(2-diisopropylaminoethyl)methylphosphonothioate
DF ^a	Methylphosphonic difluoride
QL ^a	O-(2-diisopropylaminoethyl) O'-ethyl methylphosphonite

Note:

^a Monitored as non-surety industrial chemical when stored as single chemical.

Source: Army Regulation 50-6, Appendix B.

1.3 Program Updates

The CMA Programmatic MCP will be updated periodically to ensure compliance with new regulations and to accommodate technological advances. The CMA laboratories and monitoring groups will revise their site-specific monitoring plans within a time period specified by the CMA whenever: (1) the CMA Programmatic MCP is updated, (2) new regulatory guidance is promulgated, and (3) site-specific monitoring/safety requirements are implemented or changed. Revised site-specific monitoring plans shall be submitted to the CMA-RMD for approval.

1.4 Waivers and Deviations

Requests for waivers or deviations from the minimum requirements set forth in the CMA Programmatic MCP must be submitted in writing to CMA-RMD for review and written approval prior to implementation. If the CMA Programmatic MCP is different from or conflicts with other codes or regulations from state and/or federal authorities, the CMA-RMD is to be notified for resolution of the conflict and the most stringent requirement shall be followed, pending resolution. A flow chart for the waiver process is provided in figure 1-1. Any waivers and deviations issued under Section I of PMCD Policy Statement No. 49 for research development, test, and evaluation (RDT&E) dilute operations will meet the intent of this requirement. Poor planning on the part of the CMA activity to comply with the requirements of the CMA Programmatic MCP will not justify a request for waiver. Any recommended changes to this document are to be addressed to CMA-RMD, ATTN: AMSCM-RD, Bldg. E4585, Aberdeen Proving Ground, Maryland 21010. CMA-RMD will be the approval authority for change pages and corrections to the CMA Programmatic MCP.

The waiver or deviation request shall identify the requirement of the proposed change and its impact to laboratory and monitoring operations.

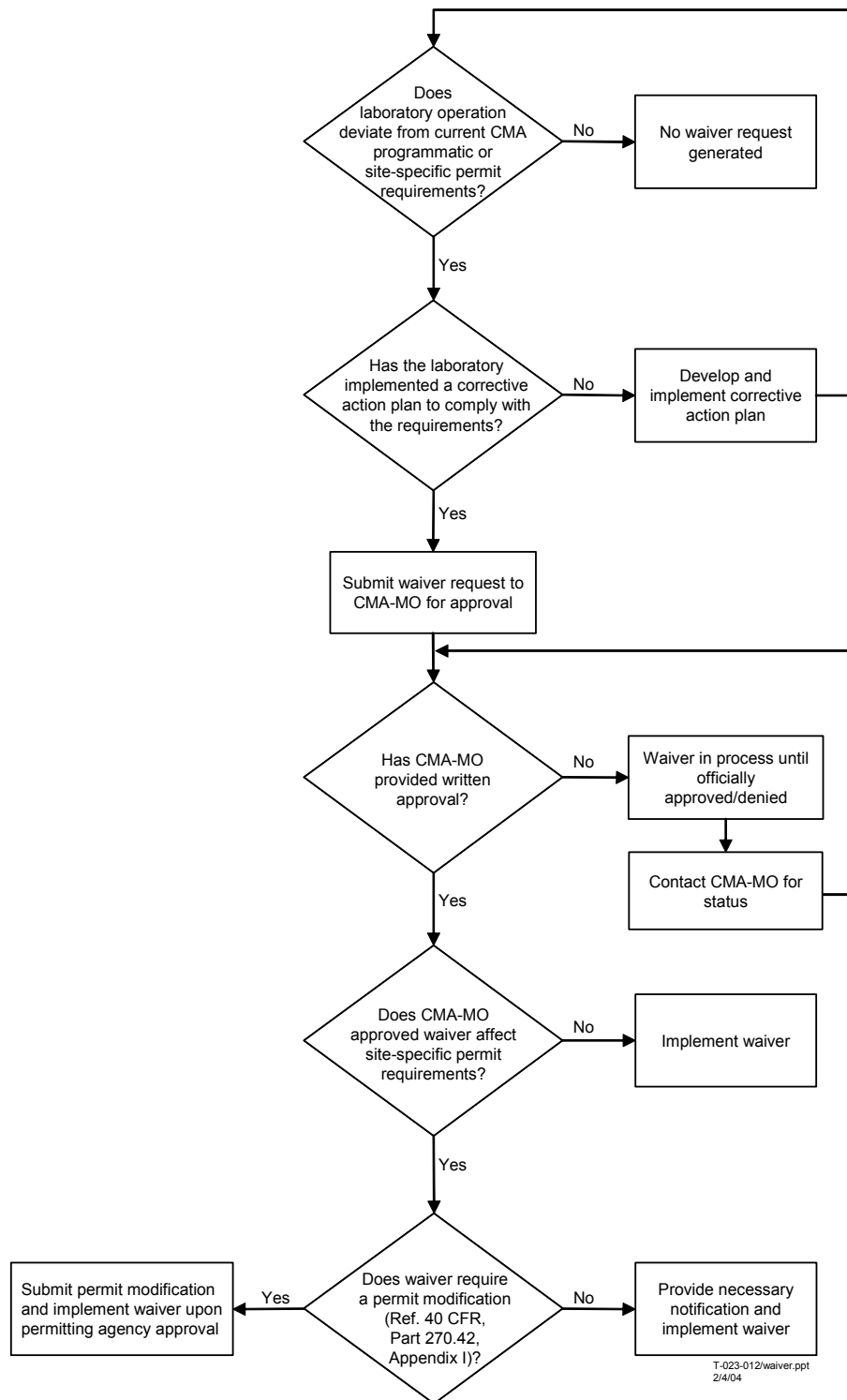


Figure 1-1. Waivers Flow Chart

1.5 Responsibility and Authority

The organizational and personnel responsibilities and authorities within the CMA monitoring program are discussed in detail in the CMA Programmatic Laboratory and Monitoring Quality Assurance Plan (LMQAP), most current revision.

1.6 Monitoring System Requirements

Information obtained from monitoring will be used to ensure that CMA operations are being conducted properly to mitigate a release of chemical materiel or personnel exposure.

Monitoring must be performed using instruments selected to measure the proper parameters for the specific chemical encountered at its associated monitoring level. Samples must be taken at intervals designed to ensure that useful information will be available within acceptable time limits. The instruments and methods used must be sufficiently sensitive to reliably measure threshold quantities at required levels. To accomplish these goals, instruments and methods used by CMA will include those specifically developed or approved by the Army to monitor chemical materiel under specific conditions in air, liquid, soils, and solids. Other methods may be used if they are more sensitive, specific, or faster and meet the requirements of the existing methods for precision, accuracy, and reliability, as described in the CMA Programmatic LMQAP, and upon approval by DA Safety.

An overriding requirement of the design and development of monitoring systems is reliable day-to-day performance. Reliability, in this context, relates to the ability of the instrument or method to perform its intended function when called upon to do so. Selection of monitoring and sampling locations is also critical to an effective monitoring program. The monitors must be positioned so that samples may be collected from representative points where any released chemical or other chemical hazard would likely be detected. Locations for ambient air monitors must be selected to provide optimum information and maximum protection for workers and the environment.

Wastes must also be sampled to provide information representative of the matrix. Location requirements for monitoring systems are provided in section 3.

1.7 Types of Monitoring Employed for Demilitarization and Storage Operations

The following types of monitoring are employed for demilitarization and storage operations of CWM:

- a. *Historical Monitoring.* Historical monitoring is performed to measure very low concentrations of airborne analytes, where contamination is unlikely or workers are operating without personal protective equipment (PPE). Sampling is accomplished by the collection of an air sample over an extended period of time (usually the duration of a workday) and subsequent analysis is conducted offline at the site laboratory. Historical monitoring is designed to trigger activities to investigate the source of contamination that may be found below the alarm level of the near real-time (NRT) monitor. All historical samples must be analyzed within 72 hours of sampling termination.
- b. *Confirmation Monitoring.* Confirmation monitoring is performed to validate or invalidate a positive measurement from another monitoring system, either an NRT method or historical method. The NRT confirmation method must be able to measure the same mass of analyte as would be collected if the sample were aspirated with air containing agent at the monitoring level during one sampling period of the co-located NRT instrument. The historical confirmation method shall measure the amount of analyte that would be measured from the sampling duration and at the aspiration rate of the historical method for the monitoring level. Sampling is accomplished by the collection of an air sample at approximately the same sampling point as the NRT monitor or historical sampling location, and subsequent analysis is conducted offline at the site laboratory. Confirmation monitoring is used for informational, qualitative, and/or

quantification data reporting purposes in the event of a chemical material release. The confirmation sample shall be analyzed by a different method (column or detector) than the NRT or historical method to minimize the likelihood of detecting interferences and only upon an NRT or historical method positive response. Confirmation monitoring samples shall be given priority over all routine samples.

- c. *NRT Monitoring.* NRT monitoring is online monitoring, conducted in areas where contamination is likely or possible, to determine airborne chemical concentration in the shortest amount of time at the monitoring level commensurate with engineering controls and worker protection. An NRT monitoring system has the capability to automatically collect, analyze, and report/display the results within 15 minutes when chemicals are present at or above the short-term exposure limit (STEL) concentration.

2. MONITORING STANDARDS AND CONTROL LIMITS

Airborne exposure limits (AELs) for tabun (GA), sarin (GB), lewisite (L), O-ethyl S-(2-diisopropylaminoethyl)methylphosphonothioate (VX), soman (GD), distilled mustard (HD), Levinstein mustard (H), mustard-T mixture (HT), nitrogen mustard (HN-1 and HN-3), and mustard-L mixture (HL) at STELs, worker population limits (WPLs), general population limits (GPLs), vapor screening limit (VSL), and source emission limits (SEL) are listed in tables 2-1 through 2-8. Industrial chemicals will be monitored to the regulatory permissible exposure limits (PELs), as specified in table 2-9.

2.1 AELs for Chemical Agents

Values identified in table 2-1 are final Centers for Disease Control and Prevention (CDC) recommendations for GA, GB, and VX. Values identified in table 2-2 are final CDC recommendations for HD AELs. Values identified in tables 2-3 through 2-8 are time and concentration derived values. These tables provide maximum concentration values not to be exceeded for a given period of time, depending on the level of protection worn by personnel. The STEL values are short-term exposure limits. Occurrences above these short-term concentrations require immediate egress and re-entry in increased level of protection. The WPL values are long-term exposure limits. If a worker is in an area for 8 hours, the average concentration in the area for the 8-hour period should not exceed the 8-hour WPL exposure limit for the level of protection worn by the worker. If the exposure limit is exceeded, implementation of corrective actions is required.

The relationship between concentration (C) and exposure time (t) is derived for vapors and gases of VX, GB, GA, H, HD, and HT as follows: $C^n t = k$, where $k = \text{constant}$ and $0.8 \leq n \leq 3.5$. This MCP assigns $n = 1$ (Haber's Law) for the WPL in the range 2 to 12 hours. This assignment is both reasonable and practical: the 8-hour WPL is actually derived from a 40-hour per week exposure limit with no recovery period considered; the WPL incorporates uncertainty factors so that it is not a precise value; and Haber's Law is more easily understood because it is computationally simple.

Table 2-1. AELs for GA, GB, and VX

AEL (mg/m ³)	GPL ^a	WPL ^a	STEL ^a	IDLH
GA/GB	1×10^{-6}	3×10^{-5}	1×10^{-4}	0.1
VX	6×10^{-7}	1×10^{-6}	1×10^{-5} ^b	0.003
Averaging Time	24 hours	8 hours	15 minutes	≤30 minutes
Monitoring Method for Recommended Exposure Criteria	Historical ^c	NRT or Historical	NRT monitor	NRT monitor

Notes:

Airborne exposure limits (AELs) are taken from 68 FR 58348-58351 (9 October 03).

- ^a An additional reduction factor for statistical assurance of action at the exposure limit is not needed because of safety factors already built into the derivation of the exposure limit.
- ^b VX STEL has been adjusted from 4×10^{-6} mg/m³ (up to four times per day) as proposed in the Federal Register (FR) announcement to 1×10^{-5} mg/m³ (not more than one time per day) based on technical capabilities of existing air monitoring technologies.
- ^c Historical monitoring typically refers to long-term sampling and analytical methods. Air monitoring results from historical methods are not known until laboratory analyses are complete.

Table 2-2. AELs for HD^a

Sulfur Mustard (H, HD, HT) ^b Criteria	GPL	WPL	STEL ^c	IDLH ^d
Exposure Level	0.00002	0.0004	0.003	0.7
Averaging Time	12 hours	8 hours	≤15 minutes	≤30 minutes
Recommended Monitoring Method	Historical ^e	Historical ^e or near real-time	Near real-time	Near real-time

Notes:

- ^a Although the Centers for Disease Control and Prevention (CDC) do not specifically recommend additional reduction factors for statistical assurance of action at the exposure limit, exposures to sulfur mustard should be minimized given the uncertainties in risk assessment, particularly as related to characterizing carcinogenic potency.
- ^b The toxicity data for agent T is inadequate for setting exposure limits. The very low vapor pressure for agent T precludes it as a vapor hazard under normal ambient conditions. For sulfur mustard and T mixtures, air monitoring for sulfur mustard alone should be sufficient under most circumstances to prevent exposure to T.
- ^c To be evaluated with a near real-time instrument using shortest practicable analytic cycle time. No more than one exposure per work-shift.
- ^d The mustard IDLH is based only on non-carcinogenic effects. No IDLH has been established for carcinogens.
- ^e Historic monitoring typically is used for time-weighted average (TWA) monitoring where the sample analyzed represents an extended time period, for example, 8 or 12 hours. Results are not known until laboratory analysis is completed after the sampling event. AELs using historic monitoring are set at levels at which health effects are not expected to occur for most workers. Exposures above the WPL-8, but below the STEL, likewise are not expected to result in significant health effects unless such exposures occur continuously for long periods.

Table 2-3. VX AELs

VX	Averaging Time						Variable
	GPL (24 hours)	WPL (12 hours)	WPL (8 hours)	WPL (4 hours)	WPL (2 hours)	STEL ^a (15 minutes)	
General Population	$6 \times 10^{-7} \text{ mg/m}^3$						
No Respiratory Protection		$6 \times 10^{-7} \text{ mg/m}^3$	$1 \times 10^{-6} \text{ mg/m}^3$	$2 \times 10^{-6} \text{ mg/m}^3$	$4 \times 10^{-6} \text{ mg/m}^3$	$1 \times 10^{-5} \text{ mg/m}^3$	
Air-Purifying Respirator		$3 \times 10^{-5} \text{ mg/m}^3$	$5 \times 10^{-5} \text{ mg/m}^3$	$1 \times 10^{-4} \text{ mg/m}^3$	$2 \times 10^{-4} \text{ mg/m}^3$	$5 \times 10^{-4} \text{ mg/m}^3$	
Supplied-Air Respirator w/o Escape Bottle		$6 \times 10^{-4} \text{ mg/m}^3$	$1 \times 10^{-3} \text{ mg/m}^3$	$2 \times 10^{-3} \text{ mg/m}^3$	$4 \times 10^{-3} \text{ mg/m}^3$	$1 \times 10^{-2} \text{ mg/m}^3$	
Self-Contained Breathing Apparatus or Supplied-Air Respirator with Escape Bottle		$6 \times 10^{-3} \text{ mg/m}^3$	$1 \times 10^{-2} \text{ mg/m}^3$	$2 \times 10^{-2} \text{ mg/m}^3$	$4 \times 10^{-2} \text{ mg/m}^3$	$1 \times 10^{-1} \text{ mg/m}^3$	
Demilitarization Protective Ensemble					100 mg/m^3 ^b		
Vapor Screening Limit							$1 \times 10^{-5} \text{ mg/m}^3$
Source Emission Limit							$3 \times 10^{-4} \text{ mg/m}^3$

Notes:

^a Exposures at the STEL shall not occur more than one time per day.

^b Implemented as a ceiling value.

Airborne exposure limits (AELs) are taken from Army Regulation 385-61 (12 October 01) and 68 FR 58348-58351 (9 October 03).

All AELs are concentration and time values, not concentration only values. Administrative controls may be used to limit potential exposure to workers. However, because administrative controls cannot be used to limit the duration of potential public exposure, only the worker population limit (WPL) protective action level is significantly affected by administrative controls, which limit the duration of potential exposure.

Table 2-3. VX AELs (Continued)

Notes: (Continued)

The maximum use concentration is the product of the AEL and the assigned protection factor for the respirator. The assigned protection factors used in this table are taken from 68 FR 34036-34119.

The demilitarization protective ensemble is only authorized for use up to 2 hours (depending on temperature). The maximum use concentration is based on extensive testing performed 1975 through 1979.

The source emission limit was previously known as the allowable stack concentration.

Table 2-4. GB/GA AELs

GB/GA	Averaging Time						Variable
	GPL (24 hours)	WPL (12 hours)	WPL (8 hours)	WPL (4 hours)	WPL (2 hours)	STEL ^a (15 minutes)	
General Population	$1 \times 10^{-6} \text{ mg/m}^3$						
No Respiratory Protection		$2 \times 10^{-5} \text{ mg/m}^3$	$3 \times 10^{-5} \text{ mg/m}^3$	$6 \times 10^{-5} \text{ mg/m}^3$	$6 \times 10^{-5} \text{ mg/m}^3$	$1 \times 10^{-4} \text{ mg/m}^3$	
Air-Purifying Respirator		$1 \times 10^{-3} \text{ mg/m}^3$	$1.5 \times 10^{-3} \text{ mg/m}^3$	$3 \times 10^{-3} \text{ mg/m}^3$	$3 \times 10^{-3} \text{ mg/m}^3$	$5 \times 10^{-3} \text{ mg/m}^3$	
Supplied-Air Respirator w/o Escape Bottle		$2 \times 10^{-2} \text{ mg/m}^3$	$3 \times 10^{-2} \text{ mg/m}^3$	$6 \times 10^{-2} \text{ mg/m}^3$	$6 \times 10^{-2} \text{ mg/m}^3$	$1 \times 10^{-1} \text{ mg/m}^3$	
Self-Contained Breathing Apparatus or Supplied-Air Respirator with Escape Bottle		$2 \times 10^{-1} \text{ mg/m}^3$	$3 \times 10^{-1} \text{ mg/m}^3$	$6 \times 10^{-1} \text{ mg/m}^3$	$6 \times 10^{-1} \text{ mg/m}^3$	1 mg/m^3	
Demilitarization Protective Ensemble					100 mg/m^3 ^b		
Vapor Screening Limit							$1 \times 10^{-4} \text{ mg/m}^3$
Source Emission Limit							$3 \times 10^{-4} \text{ mg/m}^3$

Notes:

^a Exposures at the STEL shall not occur more than four times per day, and at least 60 minutes must lapse between successive exposures.

^b Implemented as a ceiling value.

Airborne exposure limits (AELs) are taken from Army Regulation 385-61 (12 October 01) and 68 FR 58348-58351 (9 October 03).

Table 2-4. GB/GA AELs (Continued)

Notes: (Continued)

All AELs are concentration and time values, not concentration only values. Administrative controls may be used to limit potential exposure to workers. However, because administrative controls cannot be used to limit the duration of potential public exposure, only the worker population limit (WPL) protective action level is significantly affected by administrative controls, which limit the duration of potential exposure.

The maximum use concentration is the product of the AEL and the assigned protection factor for the respirator. The assigned protection factors used in this table are taken from 68 FR 34036-34119, 6 June 2003.

The demilitarization protective ensemble is only authorized for use up to 2 hours (depending on temperature). The maximum use concentration is based on extensive testing performed 1975 through 1979.

The source emission limit was previously known as the allowable stack concentration.

Table 2-5. GD AELs

GD	Averaging Time						Variable
	GPL (72 hours)	WPL (12 hours)	WPL (8 hours)	WPL (4 hours)	WPL (2 hours)	STEL (15 minutes)	
General Population	$3 \times 10^{-6} \text{ mg/m}^3$						
No Respiratory Protection		$3 \times 10^{-5} \text{ mg/m}^3$	$3 \times 10^{-5} \text{ mg/m}^3$	$3 \times 10^{-5} \text{ mg/m}^3$	$3 \times 10^{-5} \text{ mg/m}^3$	$3 \times 10^{-5} \text{ mg/m}^3$	
Air-Purifying Respirator		$1.5 \times 10^{-3} \text{ mg/m}^3$	$1.5 \times 10^{-3} \text{ mg/m}^3$	$1.5 \times 10^{-3} \text{ mg/m}^3$	$1.5 \times 10^{-3} \text{ mg/m}^3$	$1.5 \times 10^{-3} \text{ mg/m}^3$	
Supplied-Air Respirator w/o Escape Bottle		$3 \times 10^{-2} \text{ mg/m}^3$	$3 \times 10^{-2} \text{ mg/m}^3$	$3 \times 10^{-2} \text{ mg/m}^3$	$3 \times 10^{-2} \text{ mg/m}^3$	$3 \times 10^{-2} \text{ mg/m}^3$	
Self-Contained Breathing Apparatus or Supplied-Air Respirator with Escape Bottle		$3 \times 10^{-1} \text{ mg/m}^3$	$3 \times 10^{-1} \text{ mg/m}^3$	$3 \times 10^{-1} \text{ mg/m}^3$	$3 \times 10^{-1} \text{ mg/m}^3$	$3 \times 10^{-1} \text{ mg/m}^3$	
Demilitarization Protective Ensemble				See note a			
Vapor Screening Limit							$3 \times 10^{-5} \text{ mg/m}^3$
Source Emission Limit							$1 \times 10^{-4} \text{ mg/m}^3$

Notes:

^a Pending USACHPPM report, which is currently being written.

Table 2-5. GD AELs (Continued)

Notes: (Continued)

Airborne exposure limits (AELs) are taken from Army Regulation 385-61 (12 October 01).

All AELs are concentration only values, regardless of duration. Personal protective equipment (PPE) may be used to limit potential exposure to workers.

The maximum use concentration is the product of the AEL and the assigned protection factor for the respirator. The assigned protection factors used in this table are taken from 68 FR 34036-34119, 6 June 2003.

The demilitarization protective ensemble is not authorized for use with GD due to lack of testing.

The source emission limit was previously known as the allowable stack concentration.

Table 2-6. H/HD/HT AELs

H/HD/HT	Averaging Time						Variable
	GPL (12 hours)	WPL (12 hours)	WPL (8 hours)	WPL (4 hours)	WPL (2 hours)	STEL ^a (15 minutes)	
General Population	$2 \times 10^{-5} \text{ mg/m}^3$						
No Respiratory Protection		$2.7 \times 10^{-4} \text{ mg/m}^3$	$4 \times 10^{-4} \text{ mg/m}^3$	$8 \times 10^{-4} \text{ mg/m}^3$	$1.6 \times 10^{-3} \text{ mg/m}^3$	$3 \times 10^{-3} \text{ mg/m}^3$	
Air-Purifying Respirator		For sulfur mustards, air-purifying respirators are for escape purposes only.					
Supplied-Air Respirator w/o Escape Bottle		0.27 mg/m ³	0.4 mg/m ³	0.8 mg/m ³	1.6 mg/m ³	3 mg/m ³	
Self-Contained Breathing Apparatus or Supplied-Air Respirator with Escape Bottle		$2.0 \times 10^{-3} \text{ mg/m}^3$	4 mg/m ³	8 mg/m ³	16 mg/m ³	30 mg/m ³	
Demilitarization Protective Ensemble					100 mg/m ^{3b}		
Vapor Screening Limit							$3 \times 10^{-3} \text{ mg/m}^3$
Source Emission Limit							$3 \times 10^{-2} \text{ mg/m}^3$

Notes:

^a Exposures at the STEL shall occur not more than one time per day. The Centers for Disease Control and Prevention (CDC) may publish updated numbers.

^b Implemented as a ceiling value.

Table 2-6. H/HD/HT AELs (Continued)

Notes: (Continued)

Airborne exposure limits (AELs) are taken from Army Regulation 385-61 (12 October 01) and 69 FR 29164-29168 (03 May 04).

All AELs are concentration and time values, not concentration only values. Administrative controls may be used to limit potential exposure to workers. However, because administrative controls cannot be used to limit the duration of potential public exposure, only the worker population limit (WPL) protective action level is significantly affected by administrative controls, which limit the duration of potential exposure.

The maximum use concentration is the product of the AEL and the assigned protection factor for the respirator. The assigned protection factors used in this table are taken from 68 FR 34036-34119, 6 June 2003.

The mixture HT shall be monitored as HD.

The source emission limit was previously known as the allowable stack concentration.

Table 2-7. L/HL AELs

L/HL	Averaging Time						Variable
	GPL (12 hours)	WPL (12 hours)	WPL (8 hours)	WPL (4 hours)	WPL (2 hours)	STEL (15 minutes)	
General Population	$3 \times 10^{-3} \text{ mg/m}^3$						
No Respiratory Protection		$3 \times 10^{-3} \text{ mg/m}^3$	$3 \times 10^{-3} \text{ mg/m}^3$	$3 \times 10^{-3} \text{ mg/m}^3$	$3 \times 10^{-3} \text{ mg/m}^3$	$3 \times 10^{-3} \text{ mg/m}^3$	
Air-Purifying Respirator		For lewisite, air-purifying respirators are used for escape purposes only.					
Supplied-Air Respirator w/o Escape Bottle		3 mg/m^3	3 mg/m^3	3 mg/m^3	3 mg/m^3	3 mg/m^3	
Self-Contained Breathing Apparatus or Supplied-Air Respirator with Escape Bottle		30 mg/m^3	30 mg/m^3	30 mg/m^3	30 mg/m^3	30 mg/m^3	
Demilitarization Protective Ensemble ^a							
Vapor Screening Limit							$3 \times 10^{-3} \text{ mg/m}^3$
Source Emission Limit							$3 \times 10^{-2} \text{ mg/m}^3$

Notes:

^a The DPE is not authorized for use with L/HL based on testing.

Airborne exposure limits (AELs) are taken from Army Regulation 385-61 (12 October 01).

All AELs are concentration only values, regardless of duration. Personal protective equipment (PPE) may be used to limit potential exposure to workers.

The source emission limit was previously known as the allowable stack concentration.

Table 2-8. HN-1/HN-3 AELs

HN-1/HN-3	Averaging Time						Variable
	GPL (72 hours)	WPL (12 hours)	WPL (8 hours)	WPL (4 hours)	WPL (2 hours)	STEL (15 minutes)	
General Population	--	--	--	--	--	--	
No Respiratory Protection		$3 \times 10^{-3} \text{ mg/m}^3$	$3 \times 10^{-3} \text{ mg/m}^3$	$3 \times 10^{-3} \text{ mg/m}^3$	$3 \times 10^{-3} \text{ mg/m}^3$	$3 \times 10^{-3} \text{ mg/m}^3$	
Air-Purifying Respirator		For nitrogen mustards, air-purifying respirators are for escape purposes only.					
Supplied-Air Respirator w/o Escape Bottle		3 mg/m^3	3 mg/m^3	3 mg/m^3	3 mg/m^3	3 mg/m^3	
Self-Contained Breathing Apparatus or Supplied-Air Respirator with Escape Bottle		30 mg/m^3	30 mg/m^3	30 mg/m^3	30 mg/m^3	30 mg/m^3	
Demilitarization Protective Ensemble					100 mg/m^{3a}		
Vapor Screening Limit							$3 \times 10^{-3} \text{ mg/m}^3$
Source Emission Limit							--

Notes:

^a Implemented as a ceiling value.

Airborne exposure limits (AELs) are taken from Army Regulation 385-61 (12 October 01).

All AELs are concentration only values, regardless of duration. Personal protective equipment (PPE) may be used to limit potential exposure to workers.

Table 2-9. PELs for Industrial Chemicals Used as CWM

Chemical	Permissible Exposure Limit (PEL) 8-Hour TWA or 15-minute STEL		IDLH	
	(mg/m ³)	(ppmv ^a)	(mg/m ³)	(ppmv ^a)
BZ	0.004	–	0.2	0.5
Chloroform ^b	9.8 (STEL)	2 (STEL)	–	500
Chlorine ^b	1.45 (STEL)	0.5 (STEL)	29.0	10
Chloropicrin (PS) ^b	0.7	0.1	13.4	2
Cyanogen Chloride (CK) ^b	0.6	0.3	NS	NS
Hydrogen Cyanide (AC) ^b	11.0	10.0	55	50
Phosgene ^b (Diphosgene and Triphosgene) ^c	0.4	0.1	8.1	2
Arsenicals: DM, DA, DC, PD, TPA	No air monitoring required ^d	No air monitoring required ^d	No air monitoring required ^d	No air monitoring required ^d
Arsine (SA) ^b	0.2	0.05	9.57	3
DF ^e	0.008	–	NS	–
QL ^e	0.03 (0.9 STEL)	–	NS	
HF ^b	2.5	3	24.6	30

Notes:

- ^a Parts per million by volume at 20°C and 1 atmosphere
^b National Institute for Occupational Safety and Health (NIOSH) *Pocket Guide to Chemical Hazards*.
^c Monitored as phosgene.
^d Appropriate engineering/process controls shall be used to minimize exposure.
^e U.S. Army Research, Development and Engineering Center Material Safety Data Sheet.

NS: No Army or Occupational Safety and Health Administration (OSHA) standard available.
CMA-Monitoring Office shall be notified prior to operations with these chemicals, and monitoring levels will be determined on a case-by-case basis in accordance with operational protection levels.

Another assignment (n=2) may be more appropriate for acute exposures to nerve agent at concentrations much higher than the WPL; for example, acute exposure guideline level (66 FR 21940-21964 and 65 FR 14186-14197).

WPL exposure limits are not provided for GD, HN-1, HN-3, L, and HL. The STEL exposure limits shall not be exceeded at any exposure duration for these chemical agents.

2.2 PELs for Industrial Chemicals Used as CWM

Industrial chemicals will be monitored to the regulatory PELs, as specified in table 2-9. Detailed information on industrial chemicals can be located in the National Institute for Occupational Safety and Health (NIOSH) *Pocket Guide to Chemical Hazards*. This Pocket Guide can be accessed online at <http://www.cdc.gov/niosh/npg/npg.html>.

Exposure limit is an umbrella term encompassing all such limits, including the 8-hour time-weighted average (TWA), the PEL, the threshold limit value (TLV), and other levels developed to protect the worker during normal operations. Industrial chemical values, when cited, are Occupational Safety and Health Administration (OSHA) values provided in the NIOSH *Pocket Guide to Chemical Hazards*, online version. Where non-stockpile industrial chemicals STEL values exist, a 15-minute exposure limit should be used.

Exposure monitoring for industrial chemicals is a time/concentration based standard and the monitoring standard shall be based on potential exposure time (that is, 2 hours, 4 hours, 8 hours, etc.).

2.3 Exposure Limit Implementation Concept

Sites shall monitor in accordance with guidance provided in section 3. Monitoring levels at specific locations shall be based on potential time of exposure and shall consider the maximum use concentration for a given respirator protection factor. Under these conditions, different monitoring levels may be implemented, depending on the level of

PPE used and implementation of administrative controls to reduce potential exposure times.

For example, making a toxic entry into a VX-contaminated area while dressed in self-contained breathing apparatus (SCBA) has a STEL value of $1.0 \times 10^{-1} \text{ mg/m}^3$. If an NRT monitor indicates a concentration at or above this concentration, immediate corrective action is required. If the toxic entry is to be limited to a 2-hour entry, personnel may continue to work in SCBA, assuming the concentration does not exceed a 15-minute STEL and the average concentration for the 2-hour entry is below $4 \times 10^{-2} \text{ mg/m}^3$. Monitoring using this scenario can be achieved via the following implementation processes:

- The NRT monitor can be configured to monitor at the 15-minute STEL concentration of $1.0 \times 10^{-1} \text{ mg/m}^3$. When the NRT monitor alarms, corrective actions shall be implemented (that is, egress). If the STEL is not exceeded, the NRT station recorded values will be used to calculate (average) cumulative exposure concentration to ensure the long-term exposure value of $4 \times 10^{-2} \text{ mg/m}^3$ is not exceeded.
- The NRT-only monitor can be configured to monitor at the lower of the two exposure values ($4 \times 10^{-2} \text{ mg/m}^3$). When the NRT-only monitor alarms, corrective actions are implemented. This is a more conservative approach than the implementation strategy identified in the first bullet, but does not require calculation of the cumulative average (since corrective actions were implemented prior to exceeding the 2-hour average).

An individual in an area where chemical agent is known or suspected to be present (for example, “process areas” in table 3-1) should not remain in that area longer than the “averaging time” that corresponds to the respiratory protection and alarm setpoint used. The individual may exit and return to that area or another similar area repeatedly as long as the total amount of time spent in the area(s) does not exceed the “averaging time.” The individual may return to areas without a foreseeable chemical agent hazard

(for example, “facility support areas” in table 3-1) without restriction. The individual may return to areas with a foreseeable chemical agent hazard but where chemical agent is not expected (for example, “process support areas” in table 3-1) as long as a written risk assessment supports doing so.

3. MONITORING CONCEPTS

3.1 Introduction

Monitoring for toxic chemicals is a critical element for effective implementation of the U.S. Army's cardinal principle, which is defined as follows:

"The cardinal principle to be observed in any location or operation involving explosives, ammunition, or toxic chemical agents is to limit the potential exposure to a minimum number of personnel, for a minimum period of time, and to a minimum amount of the hazardous material consistent with safe and efficient operations." (DA Pam 385-61, March 2002, Paragraph 6-1).

To effectively implement the cardinal principle, engineering controls, administrative controls, and PPE each play a critical support role. Engineering and administrative controls shall be implemented, when practical, to minimize:

- Number of personnel
- Exposure time
- Toxic chemical concentration.

Use of engineering and administrative controls shall be implemented to the extent possible to reduce the PPE level of protection. When engineering and administrative controls are not practical or are determined to be insufficient, PPE shall be considered for effective mitigation of potential exposure.

Monitoring shall be used to evaluate the overall effectiveness of engineering and administrative controls, and when PPE is used, monitoring shall be used to ensure that levels, as defined in section 2, are not exceeded.

Placement of each sampling point shall be based on potential chemical migration points and verified via the use of Sulfur Hexafluoride (SF₆) or smoke tests. When monitoring supports personnel protection, monitoring locations should be located in close proximity of personnel work activities. All monitoring devices used for CWM detection shall satisfy the certification and performance requirements specified in the CMA-LMQAP, most current revision.

3.2 Monitoring Strategy for Incineration/Neutralization Facilities

A summary of the monitoring strategy for incinerator/neutralization facilities is provided in table 3-1. Detailed discussions of the monitoring locations are provided in the following paragraphs.

3.2.1 Process Areas. Chemical agent contamination, in the form of vapor or liquid/vapor, is expected to be present in these areas. Process areas are areas in the facility where the CWM is being demilitarized and may include:

- Category A/B areas
- Munitions breaching areas
- CWM transfer areas
- CWM holding areas
- Reaction/neutralization areas
- Airlocks immediately adjacent to contaminated areas.

Monitoring of process areas provides information on the level of contamination and protects workers making entries into these areas. Continuous NRT monitoring at the STEL and/or WPL will be utilized. The monitoring level will be selected in accordance with PPE level and administrative controls. No confirmation monitoring is necessary because the presence of chemical agent is expected.

Table 3-1. Summary of Monitoring Strategy for Incineration/Neutralization Facilities

Monitoring Location or Functional Activity	NRT Monitor	NRT Confirmation	Historical	Historical Confirmation	No Monitoring	Notes/Comments
Process						
Process Areas	STEL WPL					
Process Support Areas	STEL	STEL	WPL	WPL		Historical monitoring during first 5 days of chemical agent processing and then once per month (applicable to WPL only)
Workspace Process Area	STEL	STEL	WPL	WPL		
CWM Transportation Container	VSL					Headspace monitoring
Facility Support Area					X	Monitoring required within agent operating areas
Positive Pressure Support Area					X	
Medical Vestibule	STEL					
External Support Area					X	
LSS Air Connects			WPL	WPL		
Incineration Process Vapor Effluent	SEL	SEL				
Incineration Process Solid Residue Enclosures	VSL	VSL				
Neutralization Process Vapor Effluent					X	Vented into engineering controls, otherwise monitoring is required.
Demilitarization Facility Filters						
Filter Midbeds	VSL	VSL				

Table 3-1. Summary of Monitoring Strategy for Incineration/Neutralization Facilities (Continued)

Monitoring Location or Functional Activity	NRT Monitor	NRT Confirmation	Historical	Historical Confirmation	No Monitoring	Notes/Comments
Filter Vestibule/Enclosure	STEL	STEL				
Filter Operations	STEL	STEL	WPL	WPL		
Filter Stack	VSL	VSL				
PAS Filter System					X	
Laboratory						
Laboratory Work Area (Above Dilute RDT&E)	STEL	STEL	WPL	WPL		
Laboratory Work Area (Below Dilute RDT&E)					X	
Laboratory Filter					X	Filter leak test required annually.
Miscellaneous						
Perimeter			GPL	GPL		
First Entry	STEL	STEL				Confirmation not immediately required
Headspace	VSL					Historical monitoring can be substituted for NRT monitoring.

3.2.2 Process Support Areas. These are areas adjacent to process areas, are under some form of engineering and/or administrative control, and chemical agent contamination is not expected unless migration from the process area occurs. Process support areas may include:

- Category C areas
- Observation corridors
- Equipment rooms.

Process support areas require continuous NRT monitoring at the STEL and periodic (once per month) historical monitoring at the WPL. The monitoring level will be selected in accordance with the PPE level and administrative controls, but as a standard requirement, the STEL and the WPL (consistent with the site-defined work shift) for unmasked workers shall be utilized. Confirmation monitoring is required for both the NRT and historical monitoring.

During the first 5 days of chemical agent processing, process support areas require historical monitoring at the WPL with confirmation to verify the effectiveness of the engineering and administrative controls.

Process support areas that have encountered confirmed excursions above the STEL shall require continuous WPL monitoring until corrective actions (that is, engineering control and/or administrative control changes have been performed to mitigate exposure above the WPL) have been implemented and validated.

3.2.3 Workspace Process Areas. In the workspace process areas single-contained CWM may be present and personnel shall perform work on a routine basis. The workspace may be adjacent to or in the vicinity of a process area. Chemical agent contamination is not expected, but because of the nature of the operations being performed in these areas, there is a potential for contamination. Workspace process areas may include the Unpack area and the Chemical Agent Transfer System (CHATS) area.

Workspace process areas require continuous NRT monitoring at the STEL and historical monitoring at the WPL. The monitoring level will be selected in accordance with PPE level and administrative controls, but as a standard requirement, the STEL and the WPL (consistent with the site-defined work shift) for unmasked workers shall be utilized. Confirmation monitoring is required for both the NRT and historical monitoring.

3.2.4 CWM Transportation Container. Transportation containers, such as the onsite container (ONC) and enhanced onsite container (EONC), require headspace monitoring at the VSL prior to opening.

3.2.5 Facility Support Area. A facility support area is within the physical boundary of the facility, but outside agent operating areas, in an access-controlled area, and where unmasked personnel work, dress, and/or take breaks on a routine basis. Facility support areas may include:

- Category D area
- Lunch/break area
- Administrative area.

Facility support areas do not require monitoring. Lunch/break areas within agent operating areas (that is, process area, process support area, and workspace process area) require monitoring.

3.2.6 Positive Pressure Support Areas. Positive pressure support areas within the facility are provided with a positive pressure, filtered air environment. Positive pressure support areas may include:

- Category E areas
- Control room
- Medical facility.

Positive pressure support areas do not require monitoring.

3.2.7 Medical Vestibule. This area within the medical facility is under engineering controls and is designed to receive potentially contaminated casualties. During processing of a casualty through the vestibule, NRT monitoring at the STEL for an unmasked worker is required. Confirmation monitoring is not required.

3.2.8 External Support Areas. External support areas are work and break areas outside the facility physical boundary but within the host installation. External support areas may include:

- Administrative buildings
- Warehouses
- Maintenance buildings
- Shelter-in-place locations.

External support areas do not require monitoring.

3.2.9 Process Effluent. Process effluent includes the streams resulting from the demilitarization of CWM.

3.2.9.1 Incineration Process Vapor Effluent. Furnace ducts and common stack require continuous NRT monitoring at the source emission limit with confirmation monitoring. The common stack requires continuous sampling at all times. No time gaps in the common stack sampling are allowed. Probe designs shall ensure representative sample collection. The pollution abatement system (PAS) filter system does not require monitoring.

3.2.9.2 Incineration Process Solid Residue Enclosures. The incineration process solid residue enclosures may include:

- Deactivation Furnace System (DFS) cyclone enclosure
- Heated discharge conveyor (HDC) bin enclosure
- Metal Parts Furnace (MPF) discharge airlock (only applicable during processing of secondary waste items).

Solid residue enclosures require NRT monitoring at the VSL with confirmation monitoring prior to discharge and/or release from the enclosure and/or airlock.

3.2.9.3 Neutralization Process Effluent (Neutralents). The liquid effluent from the chemical neutralization of agent shall be sampled and analyzed in accordance with the requirements of section 4, Waste Streams.

3.2.9.4 Neutralization Process Vapor Effluent. If the vapor produced by or in contact with the neutralization process is not vented into engineering controls, continuous NRT monitoring at the VSL with confirmation monitoring is required.

3.2.10 Ventilation Exhaust Filter System. The ventilation exhaust filter system includes the facility's cascade ventilation system exhaust where CWM is processed for demilitarization. It does not include the laboratory ventilation system or other buildings in the facility where CWM is not processed.

3.2.10.1 Filter Midbeds. NRT monitoring at the VSL with confirmation monitoring shall be performed in at least one midbed point in the filter, such that the filter capacity behind the midbed monitoring point adequately contains the worst-case scenario as selected from the hazard analysis. Once agent breaks through to that midbed monitoring point, the charcoal immediately downstream and all charcoal upstream shall be replaced as soon as practical. Alternating the filter midbed monitoring point with the filter vestibule/enclosure monitoring point is permitted.

3.2.10.2 Filter Vestibule/Enclosure. NRT monitoring at the STEL with confirmation monitoring is required. Alternating the filter vestibule/enclosure monitoring point with the filter midbed monitoring point is permitted.

3.2.10.3 Filter Operations. The area where personnel enter into midbeds or perform bag-in/bag-out operations or other maintenance operations inside the filter enclosure, will be considered a workspace process area, subject to the monitoring requirements of paragraph 3.2.3.

3.2.10.4 Filter Stack. Continuous NRT monitoring at the VSL with confirmation monitoring is required.

3.2.11 Life Support System (LSS) Air Connects. Daily historical monitoring with confirmation monitoring at the WPL prior to use is required. The WPL monitoring level will be selected in accordance with expected maximum stay time.

3.2.12 Laboratory Work Areas. Laboratory work areas are areas where chemical agent standards are prepared or used and/or areas where samples are analyzed that may contain chemical agent. Chemical agent contamination is not expected, but because of the nature of the operations being performed in these areas, there is a potential for contamination.

3.2.12.1 Operations with Chemical Agent Above RDT&E Dilute Level. The process areas include laboratory areas where operations with chemical agent above RDT&E dilute level are conducted or where samples expected to contain chemical agent above RDT&E dilute level are analyzed. These laboratory work areas require NRT monitoring at the STEL and historical monitoring at the WPL during chemical agent operations. The monitoring level will be selected in accordance with PPE level and administrative controls, but as a standard requirement, the STEL and the WPL (consistent with the site-defined work shift) for unmasked workers shall be utilized. Confirmation monitoring is required for both the NRT and historical monitoring.

3.2.12.2 Dilute RDT&E Operations. Laboratory areas where the RDT&E dilute levels are not exceeded do not require monitoring.

3.2.13 Laboratory Ventilation Exhaust Filter System. Laboratory filters supporting neat chemical agent (above RDT&E dilute level) operations do not require monitoring if they are leak-tested at least once every 12 months. If the filters have not been leak-tested in the previous 12 months, NRT monitoring with confirmation monitoring at the VSL will be conducted while neat agent operations are performed in the laboratory. Monitoring shall be performed in at least one midbed point in the filter, such that the filter capacity behind the midbed monitoring point adequately contains the worst-case scenario as selected from the hazard analysis. Filters supporting below dilute RDT&E operations do not require filter testing or monitoring.

3.2.14 Facility/Installation Perimeter. Facility/installation perimeter monitoring applies to host installation boundary for incineration facilities or, as a minimum, facility/storage yard boundary for neutralization facilities. The number and locations of perimeter monitoring stations will be based on site-specific conditions and shall require concurrence from the CMA-RMD. Perimeter monitoring shall be performed to determine if migration of CWM to the general population was encountered. Perimeter monitoring was not designed to control disposal activities or to provide early warning of an accidental release; rather perimeter monitoring will be used to record if CWM was detected outside the facility/storage yard boundaries and to promptly investigate releases beyond environmental controls. The perimeter requires historical monitoring with confirmation monitoring at the GPL level for all chemical agents being processed at the facility or stored in the storage yard.

3.2.15 First Entry Monitoring. First entry monitoring will be conducted, prior to personnel entry, to determine the potential contamination of an enclosed area that was previously contaminated or has not been under continuous monitoring. First entries require NRT monitoring at the STEL for one complete sampling cycle of the NRT. To ensure a clean representative sample is taken, prior to monitoring for one complete sample cycle the sample line should be purged. The monitoring level will be selected in

accordance with PPE level of personnel making the entry. Confirmation monitoring is not immediately required but can be performed after the NRT response indicates possible chemical agent contamination.

3.2.16 Headspace Monitoring. Headspace monitoring may be used to screen samples to determine operational constraints, PPE requirements, handling precautions, etc.

Headspace monitoring shall be performed at the VSL on samples that have been bagged or contained in an agent-tight barrier of sufficient volume to permit sample air to be withdrawn while minimizing dilution with incoming air. One complete sampling cycle of the NRT monitor is required. Historical monitoring can be performed instead of NRT monitoring.

Note: These results may not be used to support disposition of material that requires decontamination. Headspace monitoring for the purpose of decontamination verification shall follow the requirements described in paragraph 4.4.

3.3 Monitoring Strategy for Non-Stockpile Facilities/Operations

A summary of the monitoring strategy for non-stockpile facilities/operations is provided in table 3-2. Detailed discussions of the monitoring locations are provided in the following paragraphs.

3.3.1 Process Areas. Chemical agent contamination, in the form of vapor or liquid/vapor, is expected to be present in process areas. Process areas are areas in the facility where the CWM is being demilitarized. Process areas may include:

- Munition/chemical agent identification set (CAIS) breaching areas
- Reaction/neutralization areas (glovebox, reaction vessel, process containment area).

Table 3-2. Summary of Monitoring Strategy for Non-Stockpile Facilities/Operations

Monitoring Location or Functional Activity	NRT Monitor	NRT Confirmation	Historical	Historical Confirmation	No Monitoring	Notes/Comments
Process						
Process Area						Type of monitoring will be selected in accordance with the operations as required.
Workspace Process Area	STEL	STEL	WPL	WPL		
Facility Support Area					X	Monitoring required within agent operating areas
External Support Area					X	
Demilitarization Filters						
Filter Midbeds	VSL	VSL				
Filter Operations	STEL	STEL	WPL	WPL		
Filter Stack/Exhaust	VSL	VSL	VSL	VSL		NRT monitoring will be performed if agent is detected in the filter midbed
Laboratory						
Laboratory Work Area (Above Dilute RDT&E)	STEL	STEL	WPL	WPL		
Laboratory Work Area (Below Dilute RDT&E)					X	
Laboratory Filter					X	Filter leak test required annually.
Miscellaneous						
First Entry	STEL	STEL				Confirmation not immediately required
Headspace	VSL					Historical monitoring can be substituted for NRT monitoring.

Monitoring of the process area may be conducted during operations to confirm agent identity, determine neutralization effectiveness, or to determine equipment contamination. No confirmation monitoring is necessary because the presence of chemical agent is expected.

3.3.2 Workspace Process Areas. In the workspace process areas, single-contained CWM is present and personnel perform work on a routine basis. Chemical agent contamination is not expected, but because of the nature of the operations being performed in these areas, there is a potential for contamination. Workspace process areas may include:

- Unpack area
- Process/operations trailers
- Environmental enclosures.

Workspace process areas require continuous NRT monitoring at the STEL and historical monitoring at the WPL. The monitoring level will be selected in accordance with PPE level and administrative controls, but as a standard requirement, the STEL and the WPL (consistent with the site-defined work shift) for unmasked workers shall be utilized. Confirmation monitoring is required for both the NRT and historical monitoring.

3.3.3 Facility Support Area. A facility support area is within the physical boundary of the facility but outside agent operating areas, in an access-controlled area, and where unmasked personnel work, dress, and/or take breaks on a routine basis. Facility support areas may include:

- Changeout rooms
- Maintenance buildings
- Lunch/break area.

Facility support areas do not require monitoring. Lunch/break areas within agent operating areas (that is, process area, process support area, and workspace process area) will require monitoring.

3.3.4 External Support Areas. External support areas are work and break areas outside the facility physical boundary but within the host installation. External support areas may include:

- Administrative buildings
- Warehouses
- Maintenance buildings
- Shelter-in-place locations.

External support areas do not require monitoring.

3.3.5 Ventilation Exhaust Filter System. The ventilation exhaust filter system includes the facility's ventilation system exhaust where CWM is processed for demilitarization. It does not include the laboratory ventilation system or other buildings in the facility where CWM is not processed.

3.3.5.1 Filter Midbeds. Continuous NRT monitoring at the VSL with confirmation monitoring shall be performed in at least one point in the first midbed of the filter. If agent is detected in the filter midbed, the monitoring point will be switched to the filter stack/exhaust.

3.3.5.2 Filter Operations. The area where personnel enter into midbeds or perform bag-in/bag-out operations or other maintenance operations inside the filter enclosure will be considered a workspace process area, subject to the monitoring requirements of paragraph 3.3.1.

3.3.5.3 Filter Stack/Exhaust. Continuous historical monitoring with confirmation monitoring at the VSL is required for the filter stack exhaust. NRT monitoring at the

VSL with confirmation monitoring is required after agent is detected in the filter midbed. Monitoring will be done continuously until filter changes have been made.

3.3.6 Laboratory Work Areas. Laboratory work areas are areas where chemical agent standards are prepared or used and/or areas where samples are analyzed that may contain chemical agent. Chemical agent contamination is not expected, but because of the nature of the operations being performed in these areas, there is a potential for contamination.

3.3.6.1 Operations with Chemical Agent Above RDT&E Dilute Level. The process areas include laboratory areas where operations with chemical agent above RDT&E dilute level are conducted or where samples expected to contain chemical agent above RDT&E dilute level are analyzed. These laboratory work areas require NRT monitoring at the STEL and historical monitoring at the WPL during chemical agent operations. The monitoring level will be selected in accordance with PPE level and administrative controls, but as a standard requirement, the STEL and the WPL (consistent with the site-defined work shift) for unmasked workers shall be utilized. Confirmation monitoring is required for both the NRT and historical monitoring.

3.3.6.2 Dilute RDT&E Operations. Laboratory areas where the RDT&E dilute levels are not exceeded do not require monitoring.

3.3.7 Laboratory Ventilation Exhaust Filter System. Laboratory filters supporting neat chemical agent (above RDT&E dilute level) operations do not require monitoring if they are leak-tested at least once every 12 months. If the filters have not been leak-tested in the previous 12 months, NRT monitoring with confirmation monitoring at the VSL will be conducted while neat agent operations are performed in the laboratory. Monitoring shall be performed in at least one midbed point in the filter, such that the filter capacity behind the midbed monitoring point adequately contains the worst-case scenario as selected from the hazard analysis. Filters supporting below dilute RDT&E operations do not require filter testing or monitoring.

3.3.8 First Entry Monitoring. First entry monitoring will be conducted, prior to personnel entry, to determine the potential contamination of an enclosed area that was previously contaminated or has not been under continuous monitoring. First entries require NRT monitoring at the STEL for one complete sampling cycle of the NRT. To ensure a clean representative sample is taken, prior to monitoring for one complete sampling cycle the sample line should be purged. The monitoring level will be selected in accordance with PPE level of personnel making the entry. Confirmation monitoring is not immediately required but can be performed after the NRT response indicates possible chemical agent contamination.

3.3.9 Headspace Monitoring. Headspace monitoring may be used to screen samples to determine operational constraints, PPE requirements, handling precautions, etc.

Headspace monitoring shall be performed at the VSL on samples that have been bagged or contained in an agent-tight barrier of sufficient volume to permit sample air to be withdrawn while minimizing dilution with incoming air. One complete sampling cycle of the NRT monitor is required. Historical monitoring can be performed instead of NRT monitoring.

Note: These results may not be used to support disposition of material that requires decontamination. Headspace monitoring for the purpose of decontamination verification shall follow the requirements described in paragraph 4.4.

3.4 Monitoring Strategy for Chemical Activities Operations

A summary of the monitoring strategy for chemical activities operations is provided in table 3-3. Detailed discussions of the monitoring locations are provided in the following paragraphs.

3.4.1 Storage Facilities. Periodic monitoring will be performed in storage facilities such as igloos, where CWM is stored. The chemical activity shall develop a surveillance plan to perform more frequent surveillance of storage facilities where,

because of the history of certain types or lots of CWM stored there, leakers are more likely to develop. Because the purpose of surveillance monitoring is to discover leaking munitions, NRT monitoring shall be performed at the lowest level as practical but in no case above the STEL. Confirmation monitoring is not immediately required but can be performed after the NRT response indicates possible chemical agent contamination. Historical monitoring with confirmation may be substituted for NRT monitoring.

3.4.1.1 Storage Facility Surveillance. Monitoring of storage facilities is required, as a minimum, to be performed quarterly. Monitoring of storage facilities that contain overpacked CWM is required to be performed once weekly, as a minimum.

3.4.1.2 GB M55 Rocket Facility Surveillance. Monitoring of storage facilities containing non-overpacked GB M55 rockets in designated leaker lots is required once every normal duty day. Monitoring of storage facilities containing only non-overpacked GB M55 rockets not designated as leaker lots shall be performed weekly. Frequency for monitoring of facilities containing overpacked rockets will be weekly as specified in paragraph 3.4.1.1.

Table 3-3. Summary of Monitoring Strategy for Chemical Activities

Monitoring Location or Functional Activity	NRT Monitor	NRT Confirmation	Historical	Historical Confirmation	No Monitoring	Notes/Comments
Process						
Storage Facility Surveillance	STEL	STEL	STEL	STEL		Performed at least quarterly at the lowest monitoring level as practical; not more than the STEL
Overpacked Storage Facility Surveillance	STEL	STEL	STEL	STEL		Performed at least weekly at the lowest monitoring level as practical; not more than the STEL
GB M55 Rocket Storage Facility Surveillance (with leaker lots)	STEL	STEL	STEL	STEL		Performed at least every workday at the lowest monitoring level practical; not more than the STEL
GB M55 Rocket Storage Facility Surveillance (without leaker lots)	STEL	STEL	STEL	STEL		Performed at least weekly at the lowest monitoring level as practical; not more than the STEL
Storage Filter Midbed	VSL	VSL				Performed immediately after placement into service and once every 24 hours during operation. Not required if using a passive filtration system.
Storage Filter Exhaust	VSL	VSL				Performed only after confirmed readings detected at or above the VSL in the midbed. Not required if using a passive filtration system.
Workspace Process Area	STEL	STEL	WPL	WPL		
CWM Transportation Container	VSL					Headspace monitoring
Facility Support Area					X	Monitoring required within agent operating areas
External Support Area					X	

Table 3-3. Summary of Monitoring Strategy for Chemical Activities (Continued)

Monitoring Location or Functional Activity	NRT Monitor	NRT Confirmation	Historical	Historical Confirmation	No Monitoring	Notes/Comments
Laboratory						
Laboratory Work Area (Above Dilute RDT&E)	STEL	STEL	WPL	WPL		
Laboratory Work Area (Below Dilute RDT&E)					X	
Laboratory Filter					X	Filter leak test required annually
Miscellaneous						
First Entry	STEL	STEL				Confirmation not immediately required
Headspace	VSL					Historical monitoring can be substituted for NRT monitoring.

3.4.2 Process Areas. Chemical agent contamination, in the form of vapor or liquid/vapor, is expected to be present in process areas. Process areas may include a storage igloo containing leaking CWM.

Monitoring of process areas provides information on the level of contamination and protects workers making entries into these areas. Continuous NRT monitoring at the STEL and/or WPL will be utilized. The monitoring level will be selected in accordance with PPE level and administrative controls. No confirmation monitoring is necessary because the presence of chemical agent is expected.

3.4.3 Workspace Process Areas. In the workspace process areas, single-contained CWM is present and personnel perform work on a routine basis. Chemical agent contamination is not expected, but because of the nature of the operations being performed in these areas, there is a potential for contamination. Workspace process areas may include the inside of a storage igloo while personnel are present or an area where CWM is loaded into a transportation container.

Workspace process areas require continuous NRT monitoring at the STEL and historical monitoring at the WPL. The monitoring level will be selected in accordance with PPE level and administrative controls, but as a standard requirement, the STEL and the WPL (consistent with the site-defined work shift) for unmasked workers shall be utilized. Confirmation monitoring is required for both the NRT and historical monitoring.

3.4.4 CWM Transportation Container. Transportation containers, such as the ONC and EONC, require headspace monitoring prior to opening.

3.4.5 Facility Support Area. A facility support area is within the physical boundary of the facility but outside agent operating areas, in an access-controlled area, and where

unmasked personnel work, dress, and/or take breaks on a routine basis. Facility support areas may include:

- Changeout rooms
- Maintenance buildings
- Lunch/break area.

Facility support areas do not require monitoring. Lunch/break areas within agent operating areas (that is, process area, process support area, and workspace process area) will require monitoring.

3.4.6 External Support Areas. External support areas are work and break areas outside the facility physical boundary but within the host installation. External support areas may include:

- Administrative buildings
- Warehouses
- Maintenance buildings
- Shelter-in-place locations.

External support areas do not require monitoring.

3.4.7 Storage Facility Filter System. When a powered (non-passive) filter system is required on a storage structure, NRT monitoring at the VSL shall be performed within the filter midbed immediately after placement into service and shall be performed for a minimum of two complete NRT cycles. During powered filter operation, the filter midbed shall be monitored at the VSL at least once every 24-hours. If concentration at the midbed is confirmed to be equal to or greater than the VSL, filter stack monitoring at the VSL shall be performed continuously until appropriate corrective actions have been performed. Confirmation monitoring is not immediately required but can be performed after the NRT response indicates possible chemical agent contamination. If a non-powered (passive) filter system is employed, no monitoring is required.

3.4.8 Laboratory Work Areas. Laboratory work areas are areas where chemical agent standards are prepared or used and/or areas where samples are analyzed that may contain chemical agent. Chemical agent contamination is not expected, but because of the nature of the operations being performed in these areas, there is a potential for contamination.

3.4.8.1 Operations with Chemical Agent Above RDT&E Dilute Level. The process areas include laboratory areas where operations with chemical agent above RDT&E dilute level are conducted or where samples expected to contain chemical agent above RDT&E dilute level are analyzed. These laboratory work areas require NRT monitoring at the STEL and historical monitoring at the WPL during chemical agent operations. The monitoring level will be selected in accordance with PPE level and administrative controls, but as a standard requirement, the STEL and the WPL (consistent with the site-defined work shift) for unmasked workers shall be utilized. Confirmation monitoring is required for both the NRT and historical monitoring.

3.4.8.2 Dilute RDT&E Operations. Laboratory areas where the RDT&E dilute levels are not exceeded do not require monitoring.

3.4.9 Laboratory Ventilation Exhaust Filter System. Laboratory filters do not require monitoring if they are leak-tested at least once every 12 months. If the filters have not been leak-tested in the previous 12 months, NRT monitoring with confirmation monitoring at the VSL will be conducted while neat agent operations are performed in the laboratory. Monitoring shall be performed in at least one midbed point in the filter, such that the filter capacity behind the midbed monitoring point adequately contains the worst-case scenario as selected from the hazard analysis.

3.4.10 First Entry Monitoring. First entry monitoring will be conducted, prior to personnel entry, to determine the potential contamination of an enclosed area that was previously contaminated or has not been under continuous monitoring. First entries require NRT monitoring at the STEL for one complete sampling cycle of the NRT monitor. To ensure a clean representative sample is taken, prior to monitoring for one

complete sampling cycle the sample the sample line should be purged. The monitoring level will be selected in accordance with PPE level of personnel making the entry. Confirmation monitoring is not immediately required but can be performed after the NRT response indicates possible chemical agent contamination.

3.4.11 Headspace Monitoring. Headspace monitoring may be used to screen samples to determine operational constraints, PPE requirements, handling precautions, etc.

Headspace monitoring shall be performed at the VSL on samples that have been bagged or contained in an agent-tight barrier of sufficient volume to permit sample air to be withdrawn while minimizing dilution with incoming air. One complete sampling cycle of the NRT monitor is required. Historical monitoring can be performed instead of NRT monitoring.

Note: These results may not be used to support disposition of material that requires decontamination. Headspace monitoring for the purpose of decontamination verification shall follow the requirements described in paragraph 4.4.

3.5 Monitoring Cessation

Confirmation monitoring may be suspended once CWM has been confirmed to be present (NRT-only monitoring will be required to verify effectiveness of corrective actions). Once corrective actions have resolved the confirmed CWM response, confirmation monitoring shall be re-instituted.

The site-specific monitoring plan shall describe conditions for reducing or suspending monitoring when CWM is no longer present but residual CWM contamination remains (for example, following agent changeover in a stockpile disposal facility). Conditions for reducing or suspending monitoring—that is, engineering controls, administrative controls, and PPE requirements—must adequately protect worker safety and health. The site-specific monitoring plan shall also describe conditions for resuming or

increasing monitoring again (for example, removal of major equipment or reducing PPE requirements). Monitoring of past processed agents cannot be reduced or suspended from contaminated charcoal locations until all contaminated charcoal is replaced. Monitoring may then resume in support of current agent operations. Plans shall comply with DA regulations or policies to include the *Implementation Guidance Policy For Revised Airborne Exposures Limits For GB, GA, GD, GF, VX, H, HD, and HT* (DA, most current version).

4. WASTE STREAMS

4.1 Introduction

Throughout CMA operations, wastes will require sampling and analysis to document process effectiveness and to characterize waste streams prior to offsite shipment and disposal. These requirements specify standards for the levels of certain hazardous pollutants that may be released into the environment and operating and design requirements for systems that may produce these pollutants. The monitoring requirements set forth in site-specific environmental permits will take precedence over concepts presented in this document.

4.1.1 Regulatory Basis for Monitoring Waste Streams. Federal, State, and local requirements protect human health and the environment by controlling pollution of air, water, and land resources. These requirements specify standards for the levels of certain hazardous pollutants that may be released into the environment and operating and design requirements for systems that may produce these pollutants. Additional requirements may be identified in site-specific environmental regulations.

4.1.2 Hazardous Waste Regulations. Previously buried CWM suspected of containing chemical materiel will be evaluated to determine if the contents are hazardous waste under Resource Conservation and Recovery Act (RCRA), 40 Code of Federal Regulations (CFR) Part 261. The RCRA hazardous waste management requirements and state and local requirements will dictate the conditions under which the treatment/disposal processes are operated and determine the final waste sampling and analysis required for each site. Waste sampling and analysis requirements will be outlined in the site-specific RCRA permit. Table 4-1 provides hazardous waste regulation requirements.

Table 4-1. Hazardous Waste Regulation Requirements

Hazardous Waste Regulations	Regulation Requirements
Treatment, storage, and disposal operations will be conducted in compliance with the requirements of RCRA and the associated state and local hazardous waste regulations.	<ul style="list-style-type: none"> • Developing monitoring and waste analysis plans as part of the hazardous waste permitting process • Developing an approved pre-operational test plan to ensure proper operation of the treatment/disposal system before commencing treatment/disposal operations • Conducting the test and obtaining regulatory approval of the test results • Conducting continuous monitoring of specific process parameters to ensure proper operation of the process • Sampling and analyzing specific parameters of the treatment residue waste streams to ensure treatment effectiveness and proper waste characterization • Performing periodic waste characterization analysis of waste streams to ensure compliance with the environmental standards • Developing QC and data management plans to ensure proper waste operation procedures are followed.

4.2 Sources of Waste Streams

4.2.1 Liquid Waste Streams. Liquid wastes generated during treatment operations will be sampled and analyzed as required by the following:

- Site regulations
- Waste Analysis Plan (WAP)
- Site safety plan
- Operational sampling plan.

Liquid wastes include neutralents, mechanical fluids, spent decontamination solutions, rinsewaters, laboratory waste liquids, etc.

4.2.2 Solid Waste Streams. Solid waste generated during treatment operations will be monitored and/or sampled and analyzed for chemical materiel contamination as required by the following:

- Site regulations
- WAP
- Site safety plan
- Operational sampling plan.

Solid wastes include dunnage/packing materials, spent carbon, CWM debris, used PPE, etc.

4.3 General Requirements for Monitoring Waste Materials

Table 4-2 provides the general requirements for monitoring waste materials.

4.4 Decontamination Verification Monitoring

Decontamination verification includes the following:

- The item has been surface decontaminated by locally approved procedures.
- The item has been bagged or contained in an agent-tight barrier of sufficient volume to permit sample air to be withdrawn while minimizing dilution with incoming air. Site-specific procedures shall specify time and temperature requirements.
- For PPE, the item is allowed to offgas for a minimum of 4 hours at temperatures above 70°F. PPE will be monitored and marked "Cleared for Laundry." Two options are permissible for PPE being sent to the laundry. The options are either:
 - If monitoring to the STEL is used for clearing PPE for the laundry, then the laundry facility must be continuously monitored with NRT monitors for

Table 4-2. General Requirements for Monitoring Waste Materials

Type of Waste	Required Monitoring ^a	Sample Collection
Liquid Wastes	The CMA laboratory shall verify that chemical materiel concentrations are below negotiated/approved levels. ^b	USEPA methods for representative sampling of liquid wastes shall be used as provided in SW-846 and/or USEPA-approved Army method.
	Wastes with unknown agent contamination levels will be screened for gross levels of agent contamination or diluted to allowed levels for the specific laboratory prior to low-level sample analysis.	Analysis will be performed on as required basis in accordance with the applicable Waste Analysis Plan, Site Monitoring Plan, Site-Specific Quality Control Plan, or the operational Sampling Plan.
Solid Wastes	Surface-contaminated solid waste will be analyzed for the suspected chemical materiel.	Samples are collected for semi-quantitative or quantitative laboratory analysis. Non-porous waste may be certified clean with the appropriate engineering controls.
	The air surrounding the waste will be monitored to verify that ambient concentrations of chemical materiel are below the Vapor Screening Limit.	USEPA methods for representative sampling of solid waste shall be used as provided in SW-846 and/or USEPA-approved Army method.
Complex Matrices ^c	Nonstandard test protocols should be developed, based on information from similar matrix analyses or bench study observations.	Sample collection will be based on test protocol results.

Notes:

^a Waste suspected to be contaminated should be treated as contaminated waste until the analysis is complete.

^b Approved levels are treatment goals as defined in site-specific monitoring plans.

^c Complex matrices include multiphase matrices, a non-soluble matrix, reactive/non-quenchable, or a previously unanalyzed matrix.

STEL concentrations and monitored periodically for WPL concentrations;
or

- If monitoring to the WPL is used for clearing PPE for the laundry facility, then no NRT monitoring or WPL monitoring is required.
- Less stringent monitoring conditions (but no less than one complete sampling cycle) may be used to determine operational constraints, PPE requirements, handling precautions, etc. These results may not be used to support disposition of material that requires decontamination.

Monitoring is performed with an NRT monitor, historical or confirmation method in accordance with site-specific requirements. The method shall meet the certification requirements specified in the CMA Programmatic LMQAP, most current revision.

4.5 Sample Containers

Sample containers must be:

- Chosen according to containment required
- Compatible with U.S. Environmental Protection Agency (USEPA) requirements (USEPA 1987)
- Accompanied by chain-of-custody (COC) records at all times.

4.6 Specific Requirements for Monitoring Wastes

Several specific waste streams will be generated during treatment and decontamination operations. Laboratories shall develop waste screening methods in accordance with requirements specified in the CMA Programmatic LMQAP. Sites are encouraged to use the health-risk based model to establish waste screening levels as a treatment goal.

4.7 Environmental Screening Levels for Chemical Warfare Agents

Available data and scientific methods have been evaluated for assessing potential chronic human health risks from residual chemical warfare agents in environmental media; Health Based Environmental Safety Levels (HBESLs) are derived from this information. HBESLs are concentrations of individual chemicals in environmental media, which, if not exceeded, are unlikely to present a human health hazard for specific exposure scenarios. HBESLs have been determined for soil contaminated with HD, L, GA, GB, GD, VX, S-(2-diisopropylaminoethyl) methylphosphonothioic acid (EA2192), and L oxide.

The Land Disposal Restriction levels specified in table 4-3 are values determined using a health-risk based approach and represent conservative concentration values for waste management purposes. The site is encouraged to use the health-risk based approach to develop site-specific waste levels and waste management practices associated with the waste stream.

Table 4-4 summarizes these values for chemical warfare agents in both residential and industrial soil.

The breakdown products for VX, EA2192, and the breakdown products for L, chlorovinyl arsonous acid (CVAA), L oxide, and inorganic arsenic (which is currently regulated and subject to existing USEPA screening levels), are the only potentially toxic and environmentally persistent breakdown products of the agents.

Table 4-3. Proposed Land Disposal Restriction Levels^{a,b}

Common Name(s)	Nonwastewater ^c Solids (mg/kg) ^d	Wastewater/Nonwastewater ^c Liquids (mg/L) ^e
GB, Sarin	320	8.3
GD, Soman	52	0.3
GA, Tabun	680	20
VX	10	0.08
H, HD, Mustard	6.7	0.7
L, L1 Lewisite	37	3.3
HN-1	6.7	0.7
HN-3	6.7	0.7
T Mustard	6.7	0.7

Notes:

- ^a The Land Disposal Restriction (LDR) values listed in this table reflect proposed release levels from disposal operations conducted by the Chemical Stockpile Disposal Project (CSDP). These values are not intended to replace treatment goals or release levels negotiated by the Non-Stockpile Chemical Materiel Product for primary neutralization treatment by transportable or fixed systems where final treatment and ultimate disposal occurs at a separate permitted facility.
- ^b Refer to USACHPPM Memorandum, *Response to State of Oregon Comments on the Utah Chemical Agent Rule* (UCAR), October 23, 2000, for discussion and basis of values.
- ^c As defined in 40 CFR 268.2
- ^d Milligrams per kilogram (mg/kg) is equal to parts per million (ppm).
- ^e Milligrams per liter (mg/L) is approximately equivalent to ppm.

Table 4-4. Range of Estimated HBESL Values for Chemical Warfare Agents
and Breakdown Products

	Residential Soil (mg/kg)			Industrial Soil (mg/kg)		
	RBC	PRG	SSL	RBC	PRG	SSL
HD	0.55	0.01	0.016	14	0.3	N/A
Lewisite	7.8	0.3	7.8	(7.8)	3.7	N/A
GA	3.1	2.8	0.8	82	68	N/A
GB	1.6	1.3	0.5	41	32	N/A
GD	0.31	0.22	0.18	8.2	5.2	N/A
VX	0.047	0.042	0.047	1.2	1.1	N/A
EA-2192 ^a	0.047	0.042	0.047	1.2	1.1	N/A
2-Chlorovinyl- arsonous acid/lewisite oxide ^c	7.8	0.3	7.8	(7.8) ^b	3.7	N/A

Notes:

- ^a Based on VX toxicity; parallels VX screening levels
- ^b As with lewisite calculations, Risk-Based Concentration (RBC) value derived for the commercial/industrial scenario was potentially above acute toxicity levels; therefore, the upper bound value of the residential scenario is suggested as a substitute.
- ^c These values are based on lewisite toxicity. In addition, vinyl chloride and arsenic should be evaluated during site assessments. The existing USEPA screening levels for these two compounds should be consulted.

5. DESCRIPTION AND REQUIREMENTS OF MONITORING AND SAMPLING EQUIPMENT

This section summarizes the sampling and analytical equipment required for verifying control of agent migration in air and in process effluents for CMA activities. As a starting point, all hardware associated with process monitors, air monitoring equipment, and laboratory equipment will be maintained in accordance with the manufacturers' operations and maintenance (O&M) manual recommendations.

Table 5-1 provides descriptions, operational requirements, and preventive maintenance requirements for CMA operations. Table 5-2 provides equipment requirements for support gases.

Table 5-1. Description and Requirements for Monitoring and Sampling Equipment

Monitoring Equipment	Operational Components	Manufacturer Specifications	Minimum Operational Requirements	Preventive Maintenance
<u>NRT Monitors:</u> <ul style="list-style-type: none"> ACAMS MINICAMS® A/DAM HPD <u>NRT Detectors:</u> <ul style="list-style-type: none"> FPD XSD PFPD 	<u>Operational Components:</u> <ul style="list-style-type: none"> Preconcentrator Tubes/Sample Tubes Sample Loops Capillary Columns Mass Flow Controller <u>Support Gases:</u> <ul style="list-style-type: none"> Purifiers Leak Detectors Compressed Gas Regulators 	<u>Electrical Requirements:</u> <ul style="list-style-type: none"> Critical NRT monitors equipped with UPS^a Power is provided in accordance with manufacturer specifications. <u>Temperature:</u> <ul style="list-style-type: none"> Use operational performance characteristics to determine if the NRT is operating within control. Doors to environmentally controlled NRT monitor shelter must remain closed at all times, except during personnel entry/egress. Condensation shall be minimized and if observed, corrective actions will be taken immediately. 	<ul style="list-style-type: none"> Routine Calibration Daily Challenges AgF impregnated pad required for VX monitoring unless direct VX monitoring is being performed PCT absorbent bed-depth must be a minimum of 20 mm for VX monitoring. VX monitoring with MINICAMS shall have a maximum flow rate of 400 mL/min. Calibration of mass flow meter The sample exhaust must be filtered, returned to the sampling point, or vented to appropriate engineering controls. 	<ul style="list-style-type: none"> PCT is replaced as needed, based upon challenge performance.

Table 5-1. Description and Requirements for Monitoring and Sampling Equipment (Continued)

Monitoring Equipment	Operational Components	Manufacturer Specifications	Minimum Operational Requirements	Preventive Maintenance
Depot Area Air Monitoring System (DAAMS)	<p><u>DAAMS Operational Components:</u></p> <p><u>DAAMS Tubes:</u></p> <ul style="list-style-type: none"> Size may vary depending on agent operation. <p><u>Sequencers:</u></p> <ul style="list-style-type: none"> Direct and control flow patterns <p><u>DAAMS Manifold:</u></p> <ul style="list-style-type: none"> Provides stable support system 	<p><u>Power Requirements:</u></p> <ul style="list-style-type: none"> Power is provided in accordance with manufacturer specifications. Critical DAAMS equipped with UPS^a <p><u>Temperature:</u></p> <ul style="list-style-type: none"> Temperature is maintained to minimize condensate formation. 	<ul style="list-style-type: none"> The sample exhaust must be filtered, returned to the sampling point, or vented to appropriate engineering controls. <p><u>Vacuum Pumps:</u></p> <ul style="list-style-type: none"> Used in conjunction with a flow control device or critical orifice Should maintain critical ratio of inlet to outlet vacuum across the orifice 	<ul style="list-style-type: none"> Daily checking of flow rates, critical orifices, fittings, and ferrules Vacuum pump, sequencer, and sample transfer line preventive maintenance will be performed in accordance with manufacturer specifications. Require air, nitrogen, or other inert gas flow through tube and thermal desorption of tube for conditioning

Table 5-1. Description and Requirements for Monitoring and Sampling Equipment (Continued)

Monitoring Equipment	Operational Components	Manufacturer Specifications	Minimum Operational Requirements	Preventive Maintenance
Depot Area Air Monitoring System (DAAMS) (continued)	<p><u>DAAMS Manifold</u> (Continued):</p> <ul style="list-style-type: none"> Designed to provide a directional sample flow pattern and distribute the sample flow <p><u>NOx Filter:</u></p> <ul style="list-style-type: none"> Chromosorb moisture detection disk Changeout frequency is based on a site-specific basis. 		<p><u>Hoses:</u></p> <ul style="list-style-type: none"> Used to connect sequencer sample ports to the DAAMS manifold Silastic tubing must not be used upstream of the DAAMS tube. <p><u>Manifold:</u></p> <ul style="list-style-type: none"> Fabricated from stainless steel Units that demonstrate detectable leaks, poor flow rates, or broken sections are repaired or replaced. 	

Table 5-1. Description and Requirements for Monitoring and Sampling Equipment (Continued)

Monitoring Equipment	Operational Components	Manufacturer Specifications	Minimum Operational Requirements	Preventive Maintenance
Bubbler/Impinger	<ul style="list-style-type: none"> Vacuum Sequencer Vial Assembly 	<ul style="list-style-type: none"> Vacuum pump and sequencer are operated in accordance with manufacturer specifications. <p><u>Impinger Only:</u></p> <p><u>Power Requirements:</u></p> <ul style="list-style-type: none"> Power is provided in accordance with manufacturer specifications. Critical bubbler/impinger equipped with UPS^a <p><u>Temperature:</u></p> <ul style="list-style-type: none"> Temperature is maintained to minimize condensate formation. Condensate formation shall be minimized. 	<ul style="list-style-type: none"> Vacuum pump meets specified flow rate. Sequencer directs and controls flow patterns. 	Vacuum pump and sequencer are maintained in accordance with manufacturer specifications.
<p><u>Automated Thermal Desorption Equipment:</u></p> <ul style="list-style-type: none"> Dynatherm ACEM900/980 MTDU 910 and 916 	<p><u>ACEM Operational Components:</u></p> <ul style="list-style-type: none"> Vacuum Interface Transfer Line Focusing Trap Sample Split 	<p><u>Electrical Requirements:</u></p> <ul style="list-style-type: none"> Critical unit monitors equipped with UPS Power is provided in accordance with manufacturer specifications. 	<ul style="list-style-type: none"> The MTDU may be interfaced with the ACEM to allow unattended automated analysis of multiple tubes. 	<ul style="list-style-type: none"> Performed on an "as-needed basis" in accordance with the O&M manuals

Table 5-1. Description and Requirements for Monitoring and Sampling Equipment (Continued)

Monitoring Equipment	Operational Components	Manufacturer Specifications	Minimum Operational Requirements	Preventive Maintenance
<u>GC Analytical Systems:</u> <ul style="list-style-type: none"> • FPD • FID^b • ECD • MSD • XSD • ITMS • AED 	<u>Operational Components:</u> <ul style="list-style-type: none"> • Sample inlet • Capillary column • Column switching system • Support gases • Integration system • Thermal transfer system • Exhaust • Cryofocusing • Roughing pump^c 	<u>Power Requirements:</u> <ul style="list-style-type: none"> • Power is provided in accordance with manufacturer specifications. • Confirmation monitor is equipped with UPS.^a • Power board is 120 volts alternating current. <u>Room Temperature:</u> Between 68° and 80°F during operational periods	<ul style="list-style-type: none"> • Exhaust is vented to appropriate engineering controls if required by safety analysis. • Temperature, flow rate, and desorption time shall be optimized on a site-specific basis. 	<ul style="list-style-type: none"> • Performed on an “as-needed basis” in accordance with the O&M manuals • Roughing pump oil is exchanged to maintain vacuum efficiency.
<u>Liquid Chromatography Analytic System:</u> <ul style="list-style-type: none"> • Ion Chromatograph • HPLC • LC/MS 	<ul style="list-style-type: none"> • Sample introduction system • Pump • Packed column • Support column • Support gases • Integration system 	Power is provided in accordance with manufacturer specifications.	<ul style="list-style-type: none"> • Degassing of buffer system • HPLC grade eluents 	Performed on an as-needed basis in accordance with the O&M manuals
M8A1 Monitor	<ul style="list-style-type: none"> • M43A1 detector unit • M42 alarm unit 	Power is provided in accordance with manufacturer specifications.	In accordance with O&M manual	Performed on an as-needed basis in accordance with the O&M manual
NO _x Filters	N/A	In accordance with manufacturer specifications	In accordance with manufacturer specifications	N/A

Table 5-1. Description and Requirements for Monitoring and Sampling Equipment (Continued)

Monitoring Equipment	Operational Components	Manufacturer Specifications	Minimum Operational Requirements	Preventive Maintenance
<u>Chemical Agent Detector Kits:</u> <ul style="list-style-type: none"> M256 M256A1 M272 Water Testing Kit 	12 single use sampler/detectors	In accordance with manufacturer specifications	In accordance with manufacturer specifications	N/A
<u>Colorimetric Tubes</u>	Pump and tube	In accordance with manufacturer specifications	In accordance with manufacturer specifications	In accordance with manufacturer specifications
AgF Pad ^d	Polyester pad impregnated with AgNO ₃ and KF	N/A	<ul style="list-style-type: none"> Placed at distal end^{e,f} Demonstrate transmission efficiency ≥ 75% 	Establish a changeout frequency to satisfy transmission efficiency ≥ 75%.

Notes:

- ^a The uninterruptible power supply (UPS) must have brown-out protection and constant voltage output and must operate the instruments for at least 15 minutes during a power failure.
- ^b The flame ionization detector (FID) inlet has split/splitless injection port with an autosampler.
- ^c Mass selective detector (MSD) only
- ^d AgF conversion pads cause false negative effects on GA and HD detection. Laboratories/monitoring group shall develop procedures to ensure that multiple agent monitoring for VX, HD, and GA is conducted in such a manner as not to bias GA/HD detection. If detection methods are certified to detect VX as VX, then an AgF conversion pad is not required.
- ^e The distal end is the point at which the sample enters the sample line or sample probe.
- ^f The VX pad can be recessed from the distal end at the MPF discharge airlock and DAAMS duct monitoring locations.

Table 5-2. Support Gases Equipment Requirements^a

Support Gases	Purifiers	Leak Detectors	Compressed Gas Regulators	Compressed Gas Line
<p><u>May include:</u></p> <ul style="list-style-type: none"> Hydrogen Air Nitrogen Helium Toxic gas mixtures <p>Cryofocusing requires liquid nitrogen or carbon dioxide.</p> <p>Support gases are handled and stored in accordance with the Site Chemical Hygiene Plan, which incorporates:</p> <ul style="list-style-type: none"> The CGA Pamphlet P-1; AR 700-68 CGA Pamphlet S-1.1-1963 and 1965 addendum and S-1.2-1963 29 CFR 1910.101 	<p><u>Moisture and Hydrocarbon Traps(if recommended by manufacturer or vendor):</u></p> <p>Frequency of changeouts are:</p> <ul style="list-style-type: none"> Identified in the Site-Specific Quality Control Plan Based on instrumentation performance 	<p><u>May include:</u></p> <ul style="list-style-type: none"> Simple soap solution Electronic leak detector <p><u>Utilization:</u></p> <ul style="list-style-type: none"> Completed in accordance with manufacturer specifications and requirements 	<ul style="list-style-type: none"> Will be two-stage regulators or equivalent Use of toxic chemical approved regulators for gas containing PS, CK, CG, etc. 	<ul style="list-style-type: none"> Will be pre-cleaned tubing All fittings will be Swagelok[®] fittings or equivalent.

Note:

^a Gas generators will be operated in accordance with manufacturer specifications.

6. MONITORING DOCUMENTATION REQUIREMENTS

Each CMA operation is required to prepare and retain a variety of documentation supporting the monitoring and laboratory efforts implemented at the site. Table 6-1 provides required plans. Tables 6-2 through 6-4 provide general monitoring documentation requirements. Documentation requirements for laboratory/monitoring group quality assurance (QA) are presented in the CMA Programmatic LMQAP. Additional site-specific requirements may be included in the site Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or RCRA permits and other site-specific documents.

The requirements of this CMA Programmatic MCP will be used to aid in developing a site-specific monitoring plan, which shall address, as a minimum:

- Diagram of the operational site or storage facility
- A list of the agent and munitions involved
- Detailed list and description of monitoring systems to be used
- Diagram and list of monitoring locations
- Description of sample lines
- Emergency response
- Monitoring cessation or reduction
- Monitoring continuation.

Additionally, the site-specific monitoring plan shall include a table or other suitable representation (figure) identifying the monitoring location (monitor and sampling point), monitoring level, length of sample line, monitoring frequency, type of monitoring (NRT, Depot Area Air Monitoring System (DAAMS), impinger, etc.), and any specific comments (that is, spooled lines, dilution control device, sample sequencer, etc.) that will aid in understanding the monitoring system.

In addition to the monitoring plan, the site should have other applicable documentation such as those listed in table 6-1.

Table 6-1. Required Plans

Required Monitoring Documentation	Content
Health and Safety Plan	<p>Specified in Section 126 of the Superfund Amendments and Reauthorization Act (SARA) 1986 and required by the National Contingency Plan</p> <p>To address:</p> <ul style="list-style-type: none"> • Health and safety hazards of site operation • Requirements and procedures for employee protection • Maintenance and calibration methods of monitoring and sampling equipment • Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used.
Agent Monitoring Plan	Specified in DA Pam 385-61
Waste Analysis Plan	Specified in 40 CFR 264.13
Chemical Hygiene Plan	Specified in 29 CFR 1910.120, 29 CFR 1910.1200, and 29 CFR 1910.1450
Records Management	Compliance with requirements identified in public laws, policies, and regulations of various regulatory agencies

Table 6-2. Monitoring Documentation Requirements – Confirmed Chemical Materiel

If chemical materiel is detected in unexpected areas during site operations, a confirmed chemical materiel report will be completed based on air monitoring data or results supplied by the CMA laboratory/monitoring group.

The following information will be provided:

- Identification of the chemical materiel
 - Sample ID Number\Sample Station
 - Found concentration, in mg/m³
 - Associated NRT reading (if applicable)
 - Date, time, and location of reading or measurement
 - QC sample results supporting the analytical results
 - Statement on the quality of monitoring data and printouts of the actual data
 - Any chemical materiel readings at any relevant stations at the site, destruction facility, or storage facility
 - Description of site operations during the sample aspiration period
 - A statement of the potential chemical compound's source
 - Explanation of response or operator comments
 - Name/unique ID number of operator collecting and analyzing the sample
 - Analytical method used for analysis
 - Analytical instrument ID.
-

Table 6-3. NRT Monitor Alarm Report^{a,b}

Unconfirmed Alarms	Malfunction Alarms
<p>For each unconfirmed alarm:</p> <ul style="list-style-type: none"> • Site • Chemical • Monitoring level • Station number • Date and time • Duration and value • Minimum and maximum value • Time alarm cleared • Confirmation method and associated QP recoveries. <p>Summary for reporting period:</p> <ul style="list-style-type: none"> • Total unconfirmed alarms per station. 	<p>For each malfunction alarm:</p> <ul style="list-style-type: none"> • Site • Chemical • Monitoring level • Station number • Date and time • Duration and value • Time malfunction cleared. <p>Summary for reporting period:</p> <ul style="list-style-type: none"> • Total malfunction alarms per station • Mean time between malfunctions.

Notes:

^a Reports will be submitted to CMA-Monitoring Office monthly.

^b PMNSCM operations lasting less than 2 months are required to submit a report for the operational period to CMA-Monitoring Office.

Table 6-4. Monitoring Documentation Requirements – Sample Analysis Report

- | |
|---|
| <ul style="list-style-type: none">• Title• Project name and site address• Unique ID of the report• Report recipient name and address• Description of each sample analyzed• Characterization and condition of sample• Date of sample collection and analysis• Identification of or reference to the analytical method used• Identification of or reference to the sampling method used• Identification of deviations from approved methods and other information relevant to the sample• Analytical results supported by tables, charts, sketches, or photos• QL and QP recoveries and other appropriate QC samples for the sample collection period• Signature and title of persons accepting responsibility for report contents• Results identified as performed by outside laboratories or vendors• Chain of custody. |
|---|

7. PROCEDURES FOR REPORTING POSITIVE CHEMICAL MATERIEL RESPONSES

7.1 Introduction

Due to the low monitoring levels required during CMA operations and the potential for false positive readings, the CMA laboratory/monitoring group must follow a strict protocol for reporting any chemical materiel response at or above the alarm setpoint for NRT or reportable limit for historical methods. When reporting the detection of chemical materiel, the value recorded for the primary monitoring method (quantitative method) shall be the reported value.

7.2 Alarm Setpoints/Reportable Limits

For air monitoring purposes, the CDC has stated that alarm setpoints/reportable limits can be set at the monitoring level, assuming the monitoring device has demonstrated its ability to provide ± 25 percent accuracy 95 percent of the time, with the following exception. Vapor validation testing of MINICAMS[®] for L demonstrated a negative bias. Therefore, MINICAMS configured to monitor for L shall implement an alarm setpoint at or below 0.4Z. If the NRT monitoring system cannot meet the ± 25 percent accuracy 95 percent of the time, the alarm setpoint shall be set to a conservative level to ensure detection in the event chemical materiel is present at the monitoring level. The LMQAP requires either a first challenge pass rate greater than or equal to 95 percent if the NRT alarm setpoint is 1.0Z, or a statistical response rate of 95 percent at the alarm level. Once an alarm or response above the reportable limit is encountered, corrective actions shall be implemented. All chemical materiel alarms shall be considered real until corrective actions indicate otherwise (that is, confirmation, verification of process controls, etc.).

7.3 NRT-Only Station Alarm Response

Figure 7-1 provides the response concept for NRT-only stations.

7.4 NRT Stations Coupled with Confirmation Stations

Figure 7-2 provides the response concept for NRT stations coupled with confirmation stations.

7.5 Historical-Only Stations

Figure 7-3 provides the response concepts for historical-only stations.

7.6 Low-Level NRT Monitoring Data Tracking

The CMA laboratory/monitoring group shall develop a tracking/trending protocol for sub-alarm level chemical agent STEL responses on all process support area NRT monitors. Monitoring data tracking is intended only for areas where chemical agent contamination is not expected, unmasked workers are allowed in the area, and historical WPL monitoring is not performed on a continuous basis. Chemical agent responses that are determined to be above the method limit of quantification (as determined by the precision and accuracy [P&A] study), but not below the WPL, and below the alarm level shall be tracked. The objective of the tracking protocol shall be to detect low levels of chemical agent and investigate to determine the source.

7.7 Laboratory Screening of Waste Streams

Liquid and solid samples will be collected and will be split into two samples in accordance with local approved methods. The response concept for laboratory waste and process samples is illustrated in figures 7-4 and 7-5.

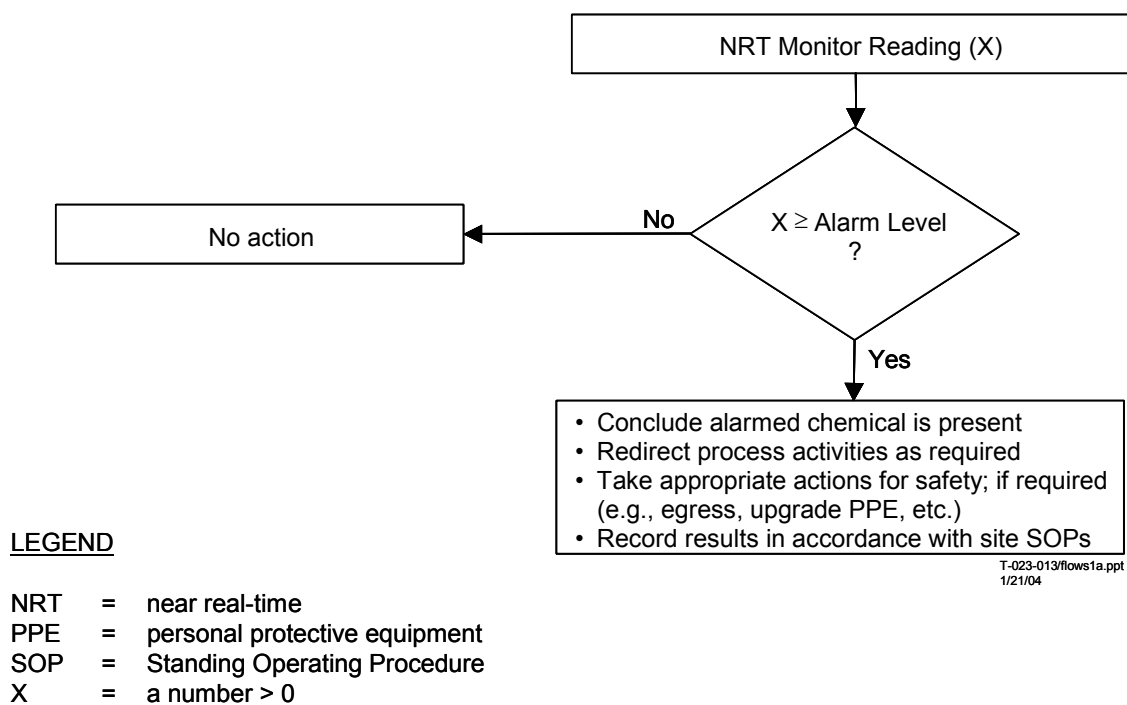
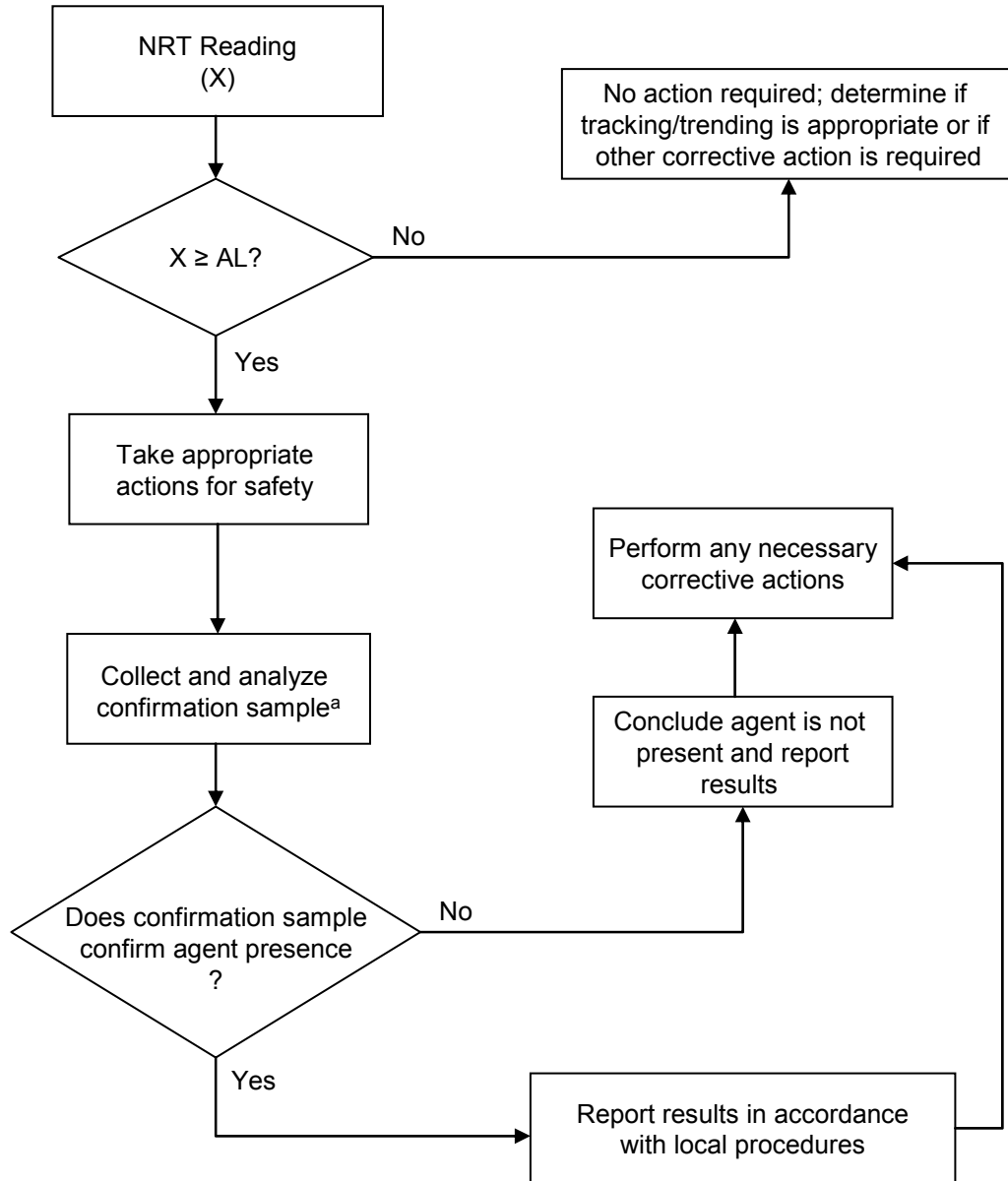


Figure 7-1. Response Concept for NRT-Only Station Alarms



T-023-013/figure 7-2(NRT-Confirmation Concept)[1].ppt
5/10/04

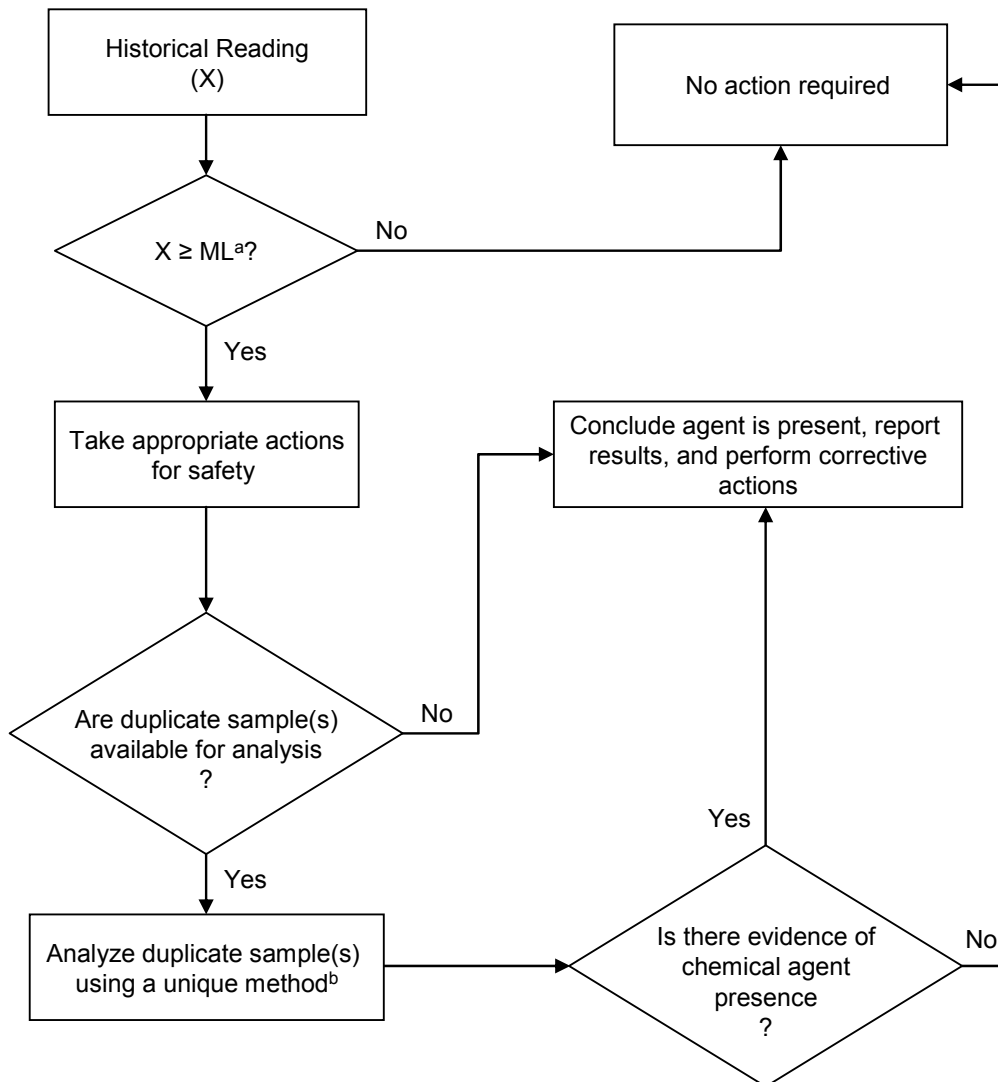
LEGEND

AL = alarm level
NRT = near real-time
X = any number > 0

Note:

^a Confirmation requires analysis on a column of differing polarity or an instrument with a different detection principle and shall have sufficient sensitivity to determine agent concentration at the monitoring level.

Figure 7-2. Response Concept for NRT Monitors Coupled with Confirmation Stations



LEGEND

ML = monitoring level
 X = any number > 0

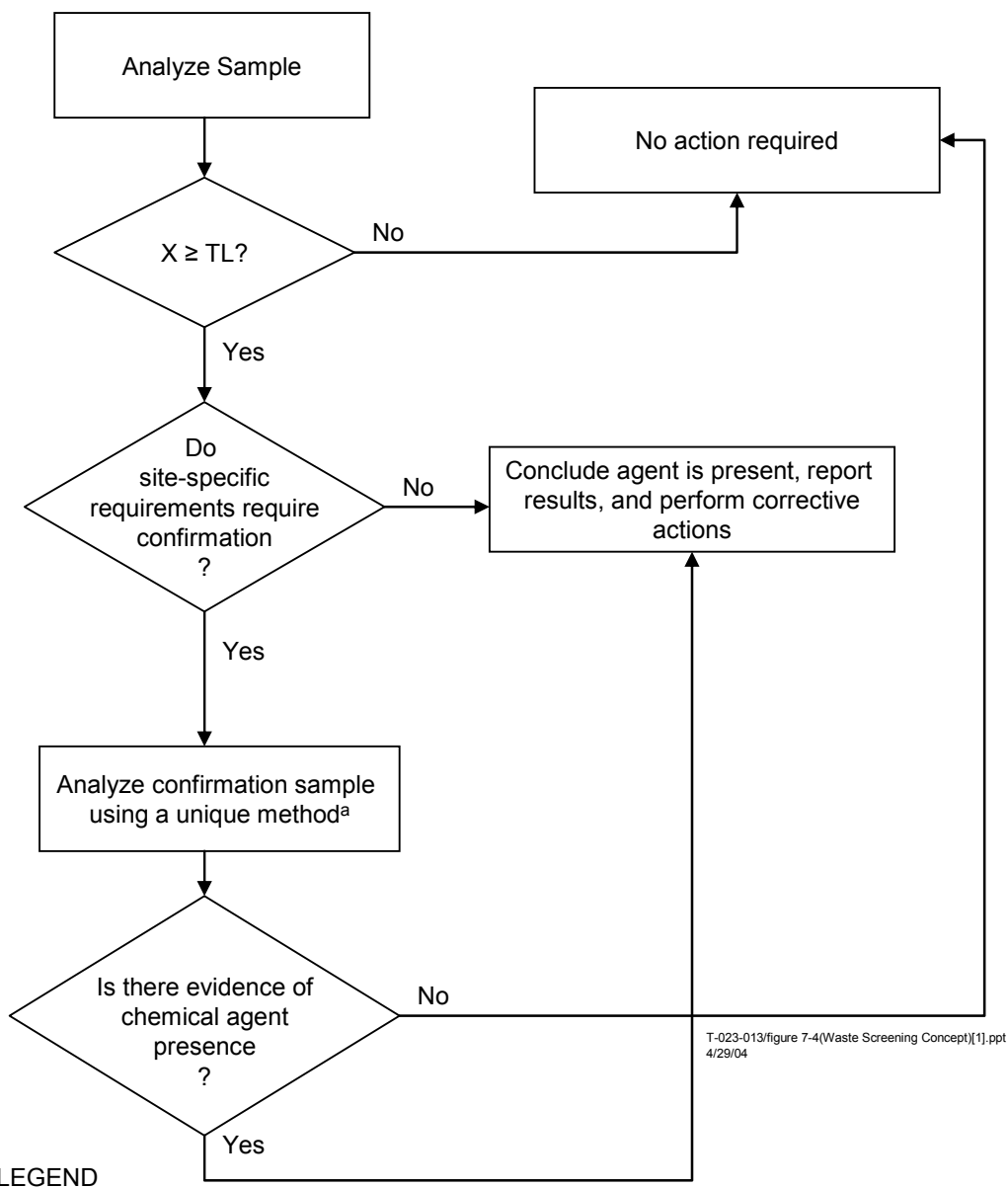
Notes:

^a Monitoring Level or Reportable Limit

^b A unique method may include analysis on a column of differing polarity or an instrument with a different detection principle and shall have sufficient sensitivity to determine agent concentration at the monitoring level.

T-023-013/figure 7-3(Historical Only Concept)[1].ppt
 4/29/04

Figure 7-3. Response Concept for Historical-Only Stations

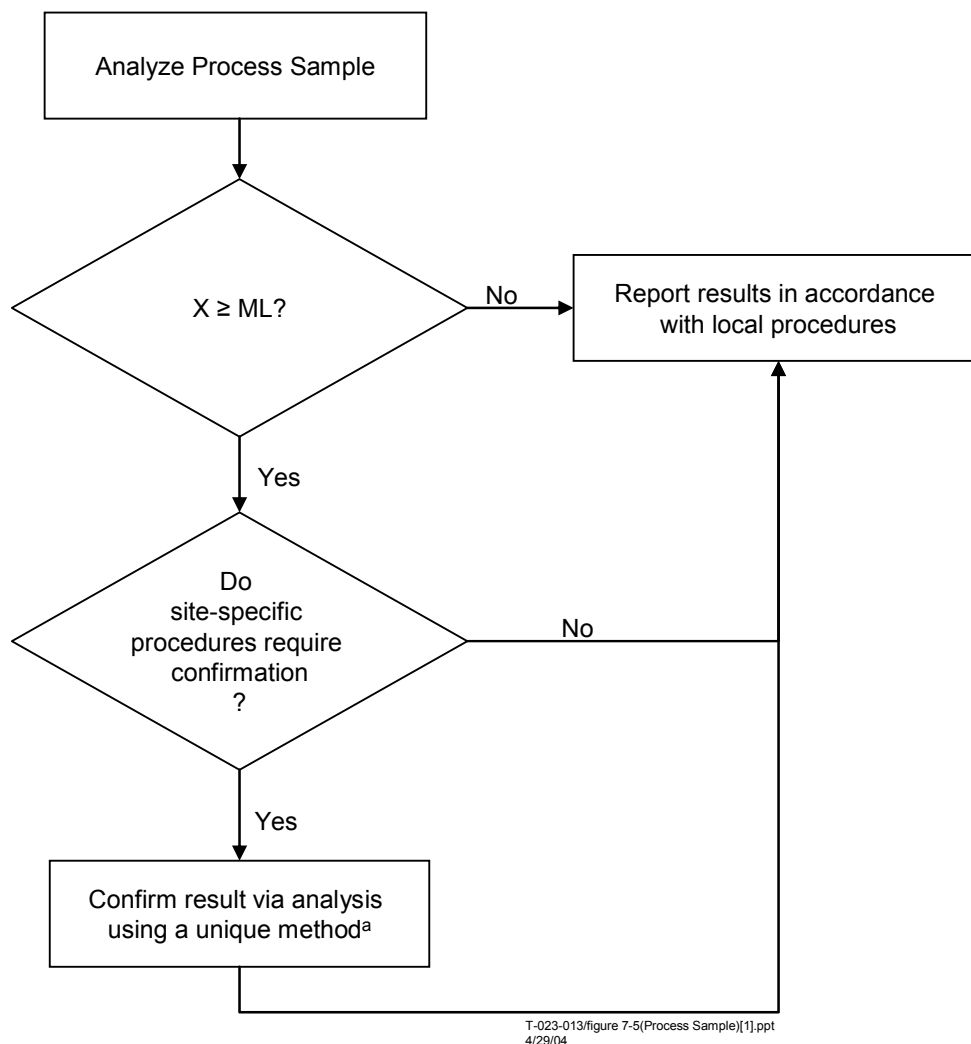


TL = treatment level
 X = any number > 0

Note:

^a A unique method may include analysis on a column of differing polarity or an instrument with a different detection principle and shall have sufficient sensitivity to determine agent concentration at the monitoring level.

Figure 7-4. Response Concept for Waste Screening



LEGEND

ML = monitoring level
 X = any number > 0

Note:

- ^a A unique method may include analysis on a column of differing polarity or an instrument with a different detection principle with sufficient sensitivity to determine agent concentration at the monitoring level.

Figure 7-5. Response Concept for Process Sample Response

7.8 Minimization of False Positive/Negative Responses

The CMA laboratory/monitoring group shall develop a plan or procedure for the minimization of false positive/negative responses from known potential interferences. As a minimum, the CMA laboratory/monitoring group shall consult the CMA Interference Database (AIDE) to identify possible interferences. The CMA laboratory/monitoring group shall test new chemicals entering the facility for their potential to initiate a false alarm and report the results to the AIDE website. When false alarms are encountered, corrective actions shall be initiated and effort should be made to identify the source and mitigate future false alarm responses. When applicable, the corrective action may result in the development of a new analytical method.

8. LIMITING CONDITIONS OF OPERATION (LCOs)

8.1 Introduction

All CMA operations are governed by LCOs or similar operational requirements. The site manager/designee will determine that all LCOs have been achieved on a daily basis. The following paragraphs present recommended minimum LCOs for laboratory/monitoring group activities at CMA sites.

8.2 Analytical Systems

LCOs for analytical systems include requirements for personnel, calibration and quality assurance/quality control (QA/QC), the CMA laboratory/monitoring group, and instrumentation. Recommended LCOs are presented in table 8-1.

8.3 Monitoring and Sampling Systems

Recommended LCOs governing personnel, calibration and QA/QC, and instrumentation for monitoring and sampling systems are identified in table 8-2.

8.4 Confirmation Monitoring

Confirmation samples shall have priority over routine samples.

Table 8-1. Recommended Laboratory LCOs

Personnel ^a	Calibration and QA/QC	CMA Laboratory Facility	Instrumentation ^a
<ul style="list-style-type: none"> • Sufficient Certified GC Operators • Sufficient Certified Laboratory Technicians and Data Management Personnel • Sufficient Certified Laboratory Management/Designee Present 	<ul style="list-style-type: none"> • Calibration and Challenge Standards Current • Operational^b Instruments Calibrated and in Control 	<ul style="list-style-type: none"> • Ventilation System (Fume Hoods) Operational • HVAC in Operational Limits (68° to 80°F) • Electrical Power Operational • Eye Washes and Safety Showers Operational • Communications Operational^d 	<ul style="list-style-type: none"> • Sufficient Number of Analytical Instruments Operational • Sufficient Support Equipment Operational^c

Notes:

- ^a Sufficient numbers of personnel and equipment are determined by the CMA laboratory based on operational experience.
- ^b Operational instruments are those that are in the field, online, and are necessary to support daily operations.
- ^c Support equipment includes vacuum pumps, pH meter, etc.
- ^d Communications can be in the form of telephone or radio communications.

Table 8-2. Recommended Monitoring LCOs

Personnel ^a	Calibration and QA/QC	Instrumentation ^a
<ul style="list-style-type: none"> • Sufficient Certified NRT Monitor Operators • Sufficient Certified Electronic Technicians • Sufficient Certified Laboratory/Monitoring Group Management/Designee Present 	<ul style="list-style-type: none"> • Agent Calibration and Challenge Standards Current • Operational^b Instruments Calibrated and in Control • Operational^b Method in Control (QPs) 	<ul style="list-style-type: none"> • Sufficient Currently Approved NRT Monitors are Operational • All Designated NRT Monitoring Locations have Equipment • Sufficient Support Equipment Operational^c • Sufficient Historical and Confirmation Sampling Equipment Operational

Notes:

^a Sufficient numbers of personnel and equipment will be determined by the laboratory/monitoring group based on operational experience.

^b Operational instruments are those that are in the field, online, and are necessary to support daily operations.

^c Support equipment includes vacuum pumps, sample probes, dilution systems, etc.

APPENDIX A

ACRONYMS/ABBREVIATIONS

APPENDIX A

ACRONYMS/ABBREVIATIONS

A/DAM	Agilent Dynatherm Agent Monitor
ABB	Asea Brown, Boveri, Inc.
AC	hydrogen cyanide
ACAMS	Automatic Continuous Air Monitoring System
ACEM	Automatic Continuous Emissions Monitor
ACGIH	American Conference of Governmental Industrial Hygienists
AEC	U.S. Army Environmental Center
AED	atomic emission detector
AEL	airborne exposure limit
AgF	silver fluoride
AgNO ₃	silver nitrate
AMC	Army Materiel Command
AR	Army Regulation
ASC	allowable stack concentration
BZ	3-quinuclidinyl benzilate
CAIS	chemical agent identification set
CAS	Chemical Abstract Service
CBD COM	U.S. Army Chemical and Biological Defense Command
CDC	Centers for Disease Control and Prevention
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CG	phosgene
CGA	Compressed Gas Association
CHATS	Chemical Agent Transfer System
CK	cyanogen chloride

CMA	U.S. Army Chemical Materials Agency
COC	chain of custody
CRDEC	U.S. Army Chemical Research, Development and Engineering Center
CSDP	Chemical Stockpile Disposal Project
CVAA	chlorovinyl arsonous acid
CWM	chemical warfare materiel
DA	Department of the Army
DAAMS	Depot Area Air Monitoring System
DC	diphenylarsine
DF	methylphosphonic difluoride
DFS	Deactivation Furnace System
DHHS	Department of Health and Human Services
DM	Adamsite
DoD	Department of Defense
DOL	Department of Labor
EA2192	S-(2-diisopropylaminoethyl) methylphosphonothioic acid
ECD	electron capture detector
EONC	enhanced onsite container
ERDEC	Edgewood Research, Development and Engineering Center
FC	found concentration
FID	flame ionization detector
FM	Field Manual
FPD	flame photometric detector
FR	Federal Register
GA	tabun
GB	sarin
GC	gas chromatograph

GD	soman
GPL	general population limit
H	Levinstein mustard
HASP	health and safety plan
HBESL	Health Based Environmental Safety Levels
HD	distilled mustard
HDC	heated discharge conveyor
HF	hydrogen fluoride
HL	mustard-lewisite mixture
HN-1, HN-3	nitrogen mustard
HPD	Hewlett-Packard Dynatherm
HPLC	high performance liquid chromatograph
HT	mustard-T mixture
HVAC	heating, ventilation, and air conditioning
IDLH	immediately dangerous to life and health
ITMS	ion trap mass spectrometer
KF	potassium fluoride
L	lewisite
LC/MS	liquid chromatograph/mass spectrometer
LCO	limiting condition of operation
LDR	land disposal restriction
LDRUG	U.S. Army Land Disposal Restrictions – Utah Group
LMQAP	Laboratory and Monitoring Quality Assurance Plan
LQCPP	Laboratory Quality Control Plan and Procedures
LSS	Life Support System

MCP	Monitoring Concept Plan
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m ³	milligrams per cubic meter
mL/min	milliliter per minute
mm	millimeter
MPF	Metal Parts Furnace
MSD	mass selective detector
MTDU	multiple tube desorption unit
N/A	not applicable
NIOSH	National Institute for Occupational Safety and Health
NO _x	nitrogen oxides
NRT	near real-time
NSCMP	Non-Stockpile Chemical Materiel Project
O&M	operations and maintenance
ONC	onsite container
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
P&A	precision and accuracy
Pam	pamphlet
PAS	pollution abatement system
PCT	preconcentrator tube
PD	phenyldichloroarsine
PEL	permissible exposure limit
PFPD	pulsed flame photometric detector
PL	Public Law
PMCD	Program Manager for Chemical Demilitarization
PMNSCM	Product Manager for Non-Stockpile Chemical Materiel

PPE	personal protective equipment
ppm	parts per million
ppmv	parts per million by volume
PQL	practical quantitation limit
PRG	Preliminary Remediation Goal
PS	chloropicrin
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
QL	quality laboratory
QL	O-(2-diisopropylaminoethyl) O'-ethyl methylphosphonite
QP	quality plant
RBC	Risk-Based Concentrations
RCRA	Resource Conservation and Recovery Act
RDT&E	research development, test, and evaluation
RMD	Risk Management Directorate
SA	arsine
SARA	Superfund Amendments and Reauthorization Act
SARM	standard analytical reference material
SBCCOM	U.S. Army Soldier and Biological Chemical Command
SCBA	self-contained breathing apparatus
SEL	source emission limit
SF6	Sulfur Hexafluoride
SOP	Standing Operating Procedure
SSL	Soil Screening Level
STEL	short-term exposure limit
SWMU	solid waste management unit

TC	target concentration
TLV	threshold limit value
TM	Technical Manual
TPA	triphenylarsine
TWA	time-weighted average
UCAR	Utah Chemical Agent Rule
UPS	uninterruptible power supply
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USACMDA	U.S. Army Chemical Materiel Destruction Agency
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USC	United States Code
USEPA	U.S. Environmental Protection Agency
WAP	Waste Analysis Plan
WPL	worker population limit
VSL	vapor screening limit
VX	O-ethyl S-(2-diisopropylaminoethyl)methylphosphonothioate
XSD	halogen selective detector

APPENDIX B

GLOSSARY OF TERMS

APPENDIX B

GLOSSARY OF TERMS

AC (Hydrogen Cyanide): AC is hydrogen cyanide, Chemical Abstracts Service (CAS) registry number 74-90-8. AC can be absorbed through the skin and mucosal surfaces, and is dangerous when inhaled because toxic amounts are absorbed through bronchial mucosa and alveoli. The toxic hazard is high for inhalation, ingestion, and skin and eye exposure, but AC is primarily an inhalation hazard due to its high volatility.

ADMINISTRATIVE CONTROL: Policies and procedures used to limit access and/or to reduce chemical exposures.

AGENT ACTIVITY/OPERATION: Any operation that involves chemical agent, including storage, shipping, handling, manufacturing, maintenance, test chamber activities, laboratory/monitoring group activities, surveillance, demilitarization, decontamination, disposal, and training.

AIRBORNE EXPOSURE LIMITS: Allowable concentrations in the air for occupational and general population exposures.

ALARM LEVEL: A predetermined value for near real-time (NRT) monitors, that when equaled to or exceeded will generate an alarm condition. For methods that demonstrate the ability to detect the analyte with ± 25 percent accuracy 95 percent of the time, the alarm level may be the monitoring level. When this criterion cannot be satisfied, the alarm should be a value lower than the monitoring level. For lewisite MINICAMS[®], the alarm level shall not exceed 0.4.

ALLOWABLE STACK CONCENTRATION (ASC): A non-regulatory ceiling value that serves as a source emission limit (SEL) and not as a health standard. It is used for monitoring the furnace ducts and common stack.

BINARY CHEMICAL MUNITIONS: Munitions designed to use two relatively nontoxic chemicals that combine during functioning of the weapon system to produce chemical warfare materiel (CWM) for release on target.

BLISTER AGENT: Chemical agent that injures the eyes and lungs and burns or blisters the skin.

BREAKDOWN PRODUCTS: Products from the chemical or thermal degradation of CWM.

BZ: The chemical 3-quinuclidinyl benzilate, CAS number 6581-06-2. BZ is a code designation for a potent psychoactive compound that has a pharmacological action similar to that of other anticholinergic drugs (atropine and scopolamine, for example) except that the effects are more severe and longer lasting. It is an odorless, white crystalline solid that in granular form may be compounded with a fuel-oxidizer mix for thermal dissemination. BZ can be absorbed through the skin; its toxic hazards exist for inhalation, ingestion, and skin exposure.

CATEGORY A AREA: The toxic processing area supported by the cascade ventilation system designated for probable liquid and vapor agent contamination (for example, munitions processing bay, toxic cubicle).

CATEGORY B AREA: The toxic processing area supported by the cascade ventilation system designated for possible vapor agent contamination only.

CATEGORY C AREA: The nontoxic work area adjacent to Category A or B areas that is supported by the cascade ventilation system designated for possible low-level vapor agent contamination (for example, observation corridors).

CATEGORY D AREA: The nontoxic work area that is supported by a cascade ventilation system designated for areas considered uncontaminated (for example, demilitarization protective ensemble support work area).

CATEGORY E AREA: The area designated for a positive pressure, filtered air environment (for example, Control Room).

CG (PHOSGENE): CG, known as carbonyl chloride or phosgene, has CAS number 75-44-5. CG is a severe eye, mucous membrane, and skin irritant and is highly toxic by inhalation. Two parts per million in air is immediately dangerous to life and health (IDLH). Being a gas, it is primarily a toxic hazard by inhalation exposure.

CHAIN OF CUSTODY (COC): An unbroken trail of accountability that ensures the physical security of samples, data, and records.

CHALLENGE: An injection of a known standard at a required monitoring level to validate that the instrument is still in control and that the calibration is valid.

CHEMICAL AGENT IDENTIFICATION SETS (CAIS): CAIS were used to train soldiers and sailors in the detection and identification of CWM, and in the proper actions to take upon detection. CAIS were produced in large quantities and various configurations during their years of manufacture (1928 through 1969) and were widely distributed to military installations for training purposes. The CAIS components are glass ampules or bottles that contain small amounts of both neat and dilute chemical agents and/or industrial chemicals that simulate chemical agents.

CHEMICAL WARFARE MATERIEL (CWM): Equipment, munitions, devices, and containers designed for use directly in connection with the employment of chemical weapons or containerization of chemical agents or industrial chemicals. This term includes the chemical weapons stockpile; chemical weapons production facilities; binary weapons and components; buried, range recovered, or found chemical munitions, containers, or CAIS.

CHLOROFORM: Chloroform, CAS number 67-66-3, is a solvent that produces hydrogen chloride, chlorine, and CG when burned. In addition to being a carcinogen, inhalation may be fatal.

CK (CYANOGEN CHLORIDE): CK is a blood poison, CAS number 506-77-4. CK is absorbed through the skin and mucosal surfaces, and is dangerous when inhaled because toxic amounts are absorbed through bronchial mucosa and alveoli. The toxic hazard is high for inhalation, ingestion, and skin and eye exposure, but it is primarily an inhalation hazard due to its high volatility.

CLOSEOUT: Completion of all related site operations.

CLOSURE: The phase of a U.S. Army Chemical Materials Agency (CMA) project that encompasses activities associated with the dismantling of the facility or removal of the mobile system, the disposal or decontamination of the components, and the restoration of the site.

COLORIMETRIC TUBES: Small glass tubes filled with solid adsorbents, such as silica gel, activated alumina, or inert granules, and impregnated with detecting chemicals through which air is aspirated at a controlled rate. The detector chemical undergoes a color change in the presence of the contaminant; the contaminant concentration is proportional to the intensity of color change or the length of the stain within the colorimetric tube.

CONFIRMATION: The process of validating or invalidating a positive response.

CORRECTIVE ACTION: Any action taken to rectify adverse conditions, and where possible, to preclude their recurrence.

DECONTAMINATION: The process of decreasing the amount of chemical agent or industrial chemical on any person, object, or area by absorbing, neutralizing, destroying, ventilating, or removing chemical agent or industrial chemical.

DEMILITARIZATION: The mutilation, destruction, or neutralization of chemical materiel, rendering it harmless and ineffectual for military purposes.

DF: A binary nerve agent, methylphosphonic difluoride (DF), CAS 679-99-3 is an organophosphonic acid. DF hydrolyzes to give MF and HF; further hydrolysis results in methylphosphonic acid. Its toxic hazard is high for inhalation, ingestion, and skin and eye exposure.

DILUTE RESEARCH DEVELOPMENT, TEST, AND EVALUATION (RDT&E)

STANDARDS: Solutions in concentrations and quantities not exceeding the levels defined in Army Regulation 50-6, Chapter 6, *Research Chemical Agents*.

DIPHOSGENE: Diphosgene or trichloromethylchloroformate is the completely chlorinated methyl ester of formic acid and is obtained by completing the chlorination of monochloromethylchloroformate. When heated to about 350°C or upon contact with moisture, it breaks down, yielding two molecules of CG.

DM (ADAMSITE): DM, CAS number 578-94-9, is a vomiting compound. It is normally a solid, but upon heating, DM first vaporizes and then condenses to form aerosols. It is toxic through inhalation, ingestion, and skin contact.

DUPLICATE SAMPLES: Also known as replicate samples or split samples, duplicate samples are two aliquots taken from the same sample container and analyzed separately to test repeatability of an analysis.

ENGINEERING CONTROL: Physical controls, such as cascade ventilation system, to control/limit contamination levels.

FOUND CONCENTRATION (FC): Concentration of a standard analyte solution measured by a sampling and analysis method after a challenge with a known standard concentration (target concentration [TC]).

GA (TABUN): The chemical ethyl-N,N-dimethylphosphoramidocyanidate, CAS number 77-81-6, in pure form and in the various impure forms that may be found in storage as well as industrial, depot, or laboratory operations. GA is a lethal

anticholinesterase agent similar in action to GB. GA vapor does not penetrate the skin, but GA liquid penetrates rapidly. The toxic hazard is high for inhalation, ingestion, and skin and eye exposure.

GB (SARIN): The chemical isopropyl methylphosphonofluoridate, CAS number 107-44-8, in pure form and in the various impure forms that may be found in storage as well as in industrial, depot, or laboratory operations. GB is a lethal anticholinesterase agent. Its toxic hazard is high for inhalation, ingestion, and eye and skin exposure. Due to its high volatility, it is mainly an inhalation threat.

GD (SOMAN): The chemical methyl-1,2,2,-trimethylpropylphosphonofluoridate, CAS number 96-64-0, in pure form and in the various impure forms that may be found in storage as well as in industrial, depot, or laboratory operations. GD is a lethal anticholinesterase agent. Its toxic hazard is high for inhalation, ingestion, and eye and skin exposure, although it is primarily a vapor hazard.

GENERAL POPULATION LIMIT (GPL): The maximum concentration to which the general population may be exposed 24 hours per day, 7 days a week, for a 70-year lifetime. Applies to the entire general population, including all ages and medical conditions.

H: Levinstein mustard, or bis(2-chloroethyl) sulfide. Mustard produced by the Levinstein process contains about 30 percent sulfur impurities. H is monitored as HD.

HAZARDOUS WASTE: A solid waste as defined in 40 Code of Federal Regulations (CFR) 261.2 is a hazardous waste if it is not excluded from regulation as a hazardous waste under 40 CFR 261.4(b) and it meets any of the criteria listed in 40 CFR 261.3(a)(2)i through v.

HD: Distilled mustard, or bis(2-chloroethyl) sulfide, CAS number 505-60-2. HD is H that has been purified by washing and vacuum distillation to reduce sulfur impurities. HD is a vesicant (blister agent) and alkylating agent, producing cytotoxic action on the

hematopoietic (blood-forming) tissues. The rate of detoxification of HD in the body is very slow, and repeated exposures produce a cumulative effect. Its toxic hazard is high for inhalation, ingestion, and skin and eye absorption, but the most common acute hazard is from liquid contact with eyes or skin.

HEADSPACE MONITORING: The process of monitoring off-gassing vapors from a substance.

HL (MUSTARD-LEWISITE MIXTURE): A mixture of 37 percent HD and 63 percent L; the mixture forms a lethal vesicant and alkylating agent producing cytotoxic action on the hematopoietic (blood-forming) tissues, which are especially sensitive.

HN (NITROGEN MUSTARD): A general class of chemical agent; the individual chemicals HN-1, HN-2, and HN-3.

HN-1 (NITROGEN MUSTARD 1): HN-1 is a vesicant and alkylating agent, 2,2'-dichlorotriethylamine, CAS number 538-07-8, producing cytotoxic action on the hematopoietic (blood-forming) tissues. Even in low concentrations, HN-1 vapors are irritating to the eyes and nasal membranes. HN-1 is not naturally detoxified by the body, and repeated exposure can produce a cumulative effect. Its toxic hazard is high for inhalation, ingestion, and skin and eye exposure.

HN-3 (NITROGEN MUSTARD 3): A vesicant, tris(2-chloroethyl)amine, CAS 555-71-1, or 817-09-4. Because its vesicant properties are almost identical to those of HD, it is the principal representative of the nitrogen mustards. It also is the most stable in storage of the three nitrogen mustards. Its toxic hazard is high for inhalation, ingestion, and skin and eye exposure.

HT: A lethal vesicant composed of approximately 60 percent HD [bis(2-chloroethyl) sulfide] and 40 percent agent T {bis[2-(2-chloroethylthio)ethyl]ether}. Both HD and T are alkylating agents. HT is monitored as HD. It is expected that the effects of HT would encompass those of both HD and T.

IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH):

- a. A condition posing an immediate threat to life or health, or an immediate threat of severe exposure to contaminants likely to have adverse delayed effects on health. This condition includes atmospheres where oxygen content by volume is less than 19.5 percent.
- b. The maximum concentration from which, in the event of a respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing (for example, severe eye irritation) or irreversible health effects.

IDLH levels have not been established for vesicants because workers are required to wear supplied air or self-contained breathing apparatus at vesicant concentrations much lower than IDLH levels. IDLH levels for industrial chemicals that may be encountered during non-stockpile operations are adopted from the National Institute for Occupational Safety and Health (NIOSH).

INDUSTRIAL COMPOUNDS: Chemicals developed or manufactured for use in industrial operations or research; these chemicals are not primarily manufactured for the specific purpose of producing human casualties or rendering equipment, facilities, or areas dangerous for use by man.

L (LEWISITE): The chemical dichloro-(2-chlorovinyl)-arsine, CAS number 541-25-3, in pure form and in the various impure forms that may be found in storage as well as in industrial, depot, or laboratory operations. L is a lethal vesicant (blister agent). The toxic hazard of L is high for inhalation, ingestion, and skin and eye exposure, although the most severe effects occur from liquid contact with eyes or skin.

LABORATORY/MONITORING GROUP: Person or person(s) responsible for performing all environmental, analytical, and safety laboratory/monitoring activities at a given site. This group has the responsibility to collect, analyze, and document samples,

preserve samples, prepare samples for offsite transportation, calibrate and challenge monitoring instruments, review sample analysis results, and report sample analysis results from laboratory/monitoring instruments.

LIMITING CONDITIONS OF OPERATIONS: Specific monitoring and laboratory conditions that must be in place before site operations are permitted to proceed.

MATRIX: The component or substrate that contains the analyte of interest.

METHOD: A set of procedures and techniques for systematically performing an activity (for example, sampling, chemical analysis, quantification). A method will encompass certain parameters that, when changed significantly, may result in a new method. Methods shall be placed under configuration control and critical parameters shall identify tolerances that, when exceeded, will result in a “new” method.

METHOD DETECTION LIMIT (MDL): The MDL refers to waste methods only. The minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyzed concentration is greater than zero and is determined from analysis of a sample in a given waste matrix containing the analyte. The MDL is the lowest level at which an analyte may be reported using that method (source is 40 CFR, Part 136, Appendix B).

MONITORING: The continued or periodic act of seeking to determine whether a chemical materiel is present (Department of the Army [DA] Pamphlet [Pam] 385-61).

MONITORING LEVEL: The level to which monitoring is performed. Responses at or above the monitoring level indicate the monitoring level has been met or exceeded and corrective actions are required. For waste screening purposes, the monitoring level is the negotiated treatment value for a specific analyte within a specific matrix.

MONITORING PLAN: A detailed, site-specific plan that covers all laboratory and monitoring objectives and strategies for a given site. The plan describes methods and

equipment used, locations, number and type of samples, safety requirements, transportation and shipping instructions, scheduling, and any other site-related monitoring requirements.

NEAT CHEMICAL AGENT: An undiluted, full-strength (as manufactured) chemical agent or agent at concentrations above RDT&E dilute level. Chemical agent manufactured by the binary synthesis route will also be considered a neat agent, regardless of purity.

NERVE AGENT: A lethal agent that causes casualties by interfering with the ability of muscles to relax after stimulation by associated nerves.

NEUTRALENT: Material remaining from the chemical neutralization of agents.

NEUTRALIZATION: The act of altering chemical, physical, and toxicological properties to render the chemical agent or industrial chemical ineffective for use as intended.

NON-STOCKPILE CHEMICAL MATERIEL PRODUCT (NSCMP): Congressionally mandated project to safely recover, store, transport, or dispose of chemical weapons materiel and manufacturing facilities in an environmentally sound manner.

PERMISSIBLE or PUBLISHED EXPOSURE LIMIT (PEL): The exposure, inhalation, or dermal PEL specified in 29 CFR Part 1910, Subparts G and Z.

PRACTICAL QUANTITATION LIMIT (PQL): The lowest concentration that can reliably be determined within specified limits of precision and accuracy for a given analytical method. The PQL is 10 times the MDL, as defined by USEPA SW-846. The PQL is applied to waste screening methods.

PS (CHLOROPICRIN): A severe respiratory irritant, CAS number 76-06-2. Persons with impaired pulmonary function may be at increased risk from exposure. Its toxic hazard exists for inhalation, ingestion, and skin and eye exposure. It is a possible but

unconfirmed tumorigenic agent that decomposes to form toxic chlorine gas and nitrogen oxides near oxygen fires.

QL: A binary nerve agent, O-ethyl-O'(2-diisopropylaminoethyl) methylphosphonite (QL), CAS number 57856-11-8, is an organophosphorus ester. It reacts with moisture and other sulfur compounds to form highly toxic and flammable materials.

QUALITY LABORATORY (QL) SAMPLE: Sampling media that has been spiked with a solution of dilute chemical standard analytical reference material (SARM). The exact amount of SARM is recorded and documented with the sample identification. The purpose of the sample is to verify the in-control status of the laboratory instrument.

QUALITY PLANT (QP) SAMPLE: Sampling media that has been spiked with a solution of dilute chemical SARM prior to being placed in the field or following aspiration of the blank tube in the field. The sample is spiked and then carried out to the sample collection point and exposed to the sample collection point atmosphere. The exact amount of SARM is recorded and documented with the sample identification (target concentration). Upon analysis in the laboratory, the QPs found mass must be within an acceptable tolerance. The purpose of the sample is to identify sources of sample contamination or sample degradation in the field at the sample collection location.

REPORTABLE LIMIT: A predetermined value for historical method, that when equaled or exceeded will be reported as chemical material that may have exceeded the monitoring level.

RESEARCH DEVELOPMENT, TEST, AND EVALUATION (RDT&E) STANDARDS:
Army Regulation 50-6, Chapter 6, *Research Chemical Agents*.

SAMPLE: Physical evidence collected for environmental measuring and monitoring.

SAMPLING: The physical collection of a representative portion of the population, universe, or environment.

SAMPLING PLAN: A detailed, site-specific plan that covers all sampling objectives and strategies for a given site. The plan describes methods and equipment used, locations, number and type of samples, safety requirements, transportation and shipping instructions, scheduling, and any other site-related sampling requirements.

SHORT-TERM EXPOSURE LIMIT (STEL): The maximum concentration to which unprotected chemical workers may be exposed for up to 15 minutes continuously.

SOLID WASTE: Discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended.

SOURCE EMISSION LIMIT (SEL): The SEL replaces the previously used allowable stack concentration (ASC). SELs are identified in section 2.

STANDARD: A known concentration of a known chemical that is used to perform quantitative analysis.

STANDING OPERATING PROCEDURE (SOP): A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps, and that is officially approved as the method for performing certain routine or repetitive tasks.

SWIPE SAMPLE: A sample used to assess surface contamination. Swipe samples are collected by wiping contamination from the object onto a clean filter or wipe. The contamination is then extracted from the wipe into a solvent and analyzed in the laboratory.

T: Agent T is a mustard, CAS number 63918-89-8, with an estimated human lethal dose for inhalation that is much less than that for HD. The biological effects observed

after animal exposure to HT are similar to those induced by HD, although induction following HT exposure is more rapid and/or severe. This greater activity is a result of the presence of stable agent T in the mixture; the more volatile HD dissipates and leaves a reactive blend containing a higher concentration of T.

TIME-WEIGHTED AVERAGE (TWA): A maximum level or concentration of a chemical agent, averaged over an 8-hour day, to which employees may be exposed.

TREATMENT LEVEL: A negotiated concentration for a specified contaminant in a specified extract or total waste that must be met by any method designed to physically or chemically change the nature of a hazardous waste.

VAPOR SCREENING LEVEL (VSL): The level to which an item is monitored to determine the level of cleanliness. Typically done by containing the item in an enclosed space to limit incoming dilution. See Army Regulation 385-61.

VESICANT AGENT: Agent that acts on the eyes and lungs and blisters the skin.

VX: The chemical O-ethyl S-(2-diisopropylaminoethyl)methylphosphonothioate, CAS number 50782-69-9, in pure form and in the various impure forms that may be found in storage as well as in industrial, depot, or laboratory operations. VX is a lethal anticholinesterase chemical materiel. Its toxic hazard is high for inhalation, ingestion, and eye and skin exposure, but due to its low volatility, the primary route of exposure is through ingestion or skin contact.

WORKER POPULATION LIMIT (WPL): Maximum allowable 8-hour TWA concentration that an unmasked worker could be exposed to for an 8-hour workday and 40 hours per week for 30 years without adverse effect. WPL values are identified in section 2.

Z: Generic designation for the applicable monitoring level.

APPENDIX C

REFERENCES

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REFERENCES

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